



*File:
Dusable Park*

**RIVER WALL CONDITION ASSESSMENT AND
PRELIMINARY REPAIR COST ESTIMATE FOR
PROPOSED DUSABLE PARK DEVELOPMENT**

Prepared for

Chicago Park District

By

HARZA
Engineering Company, Inc.

March 2001



chicago park district

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November 28, 2001

Mary Fulghum
United States Environmental
Protection Agency Region 5
77 West Jackson Blvd.
Chicago, IL 60604-3590

Re: DuSable Park

Dear Mary:

As you requested, enclosed please find a copy of Harza
Engineering's March 2001 report on the river wall at DuSable Park.

Very truly yours,

A handwritten signature in cursive script, appearing to read "Joan".

Joan Ferick
General Counsel

Enclosure

C: Colleen Mueller
Robert Megquier

/nm

CHICAGO
PARK
DISTRICT
come out
and play

EXECUTIVE SUMMARY

The Chicago Park District intends to initiate planning for the development of an unused parcel of land at the mouth of the Chicago River, currently known as "DuSable Park". The 3.5-acre site is bounded on the North, East and South sides by the Chicago River and Ogden Slip, with each of the sides comprising vertical sheet pile river walls. The West boundary of the property is formed by Lake Shore Drive. As a precursor to further planning initiatives the Park District requires information regarding the condition of the existing river walls and an estimate of the likely level of effort required to restore the walls to a condition suitable for the proposed use.

In 1997, Harza Engineering Company performed a condition assessment and structural analysis for the site under subcontract to Johnson, Johnson & Roy, Inc. The purpose of this present study is to prepare a supplemental report that describes the current conditions and to present conceptual level cost estimates for typical repairs that may be required before a park can be constructed. Comparative analyses have been prepared to estimate the potential impact of several development concepts on the existing river wall.

A condition assessment of the existing river wall was conducted as part of the current study. The inspection consisted of examining only the above water portion of the structure from the landside. No underwater inspection, or water-based inspection was performed. The condition assessment found that the southeast corner and a portion of the north wall were most in need of repairs. The needed repairs were divided into three main groups; partial wall replacement, wall stabilization and wall patching. The approximate extent and cost of each type of repair was assessed. In addition a cost estimate for entire replacement of the existing wall with a new wall was prepared. The following table summarizes the cost of the proposed repairs.

Location	Type of Repairs	Estimated Cost*
South Wall	Wall Patching	\$ 18,000
Southeast Corner	Wall Replacement	\$ 235,000
East Wall and Northeast Corner	Wall Patching	\$ 21,000
North Wall	Wall Stabilization (30 ft.) and Wall Patching	\$ 63,000
Common Items	Mobilization, Demobilization, Temporary Facilities and Demolition	\$ 38,000
Total (Minimum Recommended Repairs)		\$ 375,000
Total Wall Replacement (approx. 1,100 feet)		\$ 2,500,000

Table ES - 1 Summary of Recommended Repairs and Cost Estimates

A park development concept (supplied by others) for the site was selected for analysis purposes. No inference should be made as to the desirability of this particular plan, or the schedule for development. The concept is for a park development that substantially re-grades the existing site. The purpose of these analyses was to define and quantify general development parameters that minimize negative impacts and/or maximize positive impacts to the river wall.

Due to the number of unknown parameters regarding the river wall (including depth of embedment, subsurface condition, and initial construction) development scenarios that do not increase the load on the existing wall are recommended. If development scenarios that increase the loads on the wall are preferred, significant modifications and/or wall replacement will be required depending on the proposed park configuration.

* These cost estimates are based on the assumption that no significant new loads are applied to the river walls. Section 7 contains further discussion regarding the cost implications of load variations.

RIVER WALL CONDITION ASSESSMENT AND PRELIMINARY REPAIR COST ESTIMATE FOR PROPOSED DUSABLE PARK DEVELOPMENT

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>PAGE</u>
EXECUTIVE SUMMARY.....	ES-1
FOREWORD	1
1.0 INTRODUCTION.....	2
2.0 SITE DESCRIPTION	4
3.0 SUMMARY OF PREVIOUS CONDITION ASSESSMENT.....	6
4.0 FINDINGS OF 2001 CONDITION ASSESSMENT	7
4.1 General Conditions.....	7
4.2 Specific Conditions	7
4.2.1 South Wall.....	7
4.2.2 South East Corner.....	7
4.2.3 East Wall	8
4.2.4 North East Corner.....	8
4.2.5 North Wall.....	8
4.3 Future Inspections	8
5.0 PROPOSED REPAIRS	9
5.1 Introduction	9
5.2 South Wall.....	9
5.3 Southeast Corner	10
5.4 East Wall	10
5.5 Northeast Corner	10
5.6 North Wall.....	11
5.7 Recommended Maintenance Work	11
5.7.1 Fender Supports.....	11
5.7.2 Channel Cap	12

5.8	Typical Construction Sequence for Repairs and Maintenance Work	12
6.0	COST ESTIMATES.....	14
6.1	Introduction	14
6.2	Methodology	14
6.3	Minimum Recommended Repairs.....	14
6.4	Complete Replacement of River Wall	15
6.5	Life-Cycle Cost Analysis	16
6.5.1	Minimum Recommended Repairs.....	16
6.5.2	Complete Wall Replacement.....	17
6.5.3	Results	17
6.6	Evaluation of Advantages and Disadvantages of Partial or Complete Wall Rehabilitation	17
6.6.1	Partial Wall Rehabilitation	18
6.6.2	Complete Wall Replacement.....	18
7.0	ENGINEERING EVALUATION.....	19
7.1	Introduction	19
7.2	Methodology	19
7.3	Study Cases	21
7.3.1	Baseline Case	21
7.3.2	Existing Conditions	22
7.3.3	Use of Lightweight Fill	22
7.3.4	Addition of Surcharge at the Toe of the Structure	23
7.3.5	Lowering of the Top of Wall.....	24
7.3.6	Temporary Construction Loads.....	25
7.3.7	Park Development	26
8.0	SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	29
8.1	Summary	29
8.2	Conclusions	30
8.3	Recommendations	32
	REFERENCES.....	R-1
	EXHIBITS.....	E-1
	APPENDICES.....	A-1

LIST OF TABLES

Table ES-1 Summary of Recommended Repairs and Cost Estimates.....	ES-2
Table 6-1 Breakdown of Minimum Recommended Repairs by Location	15
Table 7-1 Comparison Between Existing Conditions and Baseline Case.....	22
Table 7-2. Comparison Between Lightweight Fill and Baseline Case	23
Table 7-3. Comparison Between Toe Surcharge and Baseline Case	24
Table 7-4. Comparison Between Lower Wall and Baseline Case	25
Table 7-5. Comparison Between Construction Loads and Baseline Cases.....	26
Table 7-6. Comparison Between Proposed Park and Baseline Conditions.....	27

APPENDICES

APPENDIX A	COST ESTIMATES
APPENDIX B	LIFE-CYCLE COST ANALYSIS
APPENDIX C	ENGINEERING EVALUATION

FOREWORD

Authorization

This study was completed under the authority of Designer/Consultant Agreement (Specification No. 98194) between the Chicago Park District and Harza Engineering Company, Inc. (Project No. 15442C).

Scope

The purpose of this report is to summarize the condition assessment of the DuSable Park river wall, evaluate the potential impacts to the river wall due to a proposed development scenario and to prepare cost estimates for repairs to the wall necessary to support the proposed development scenario.

Acknowledgments

This report was prepared on behalf of Robert Megquier, Director of Planning and Development and Mitch Glass, Project Manager, Chicago Park District. The report was prepared by or under the supervision of Mark Wagstaff, Project Manager, and Mark Calvino, Midwest Regional Manager of Infrastructure, Harza Engineering Company, Inc.

1.0 INTRODUCTION

The Chicago Park District (Park District) is considering park development alternatives for a 3.5-acre parcel of land bordered by the Chicago River on the east and south, Ogden Slip to the north and Lake Shore Drive on the west. The parcel is referred to as DuSable Park. The south, east and north perimeters comprise vertical steel sheet pile river walls. Further details of the site are included in Section 2, Site Description. As a precursor to the initiation of the development process the Park District requires information regarding the condition of the river walls and the potential costs associated with repairs that may be needed.

Harza Engineering Company, Inc. has performed a previous condition assessment of the river walls (DuSable Park Development, River Wall Condition Assessment, 1997), which included surface inspection, underwater inspection and engineering analysis. Further details of the 1997 work are included in Section 3, Summary of Previous Condition Assessment. The present report is intended as a supplement to the work performed in 1997. The present study was authorized to attempt to identify areas of the site that have deteriorated significantly since the last inspection and to examine the potential impacts of different development scenarios. To this end a site inspection was carried out. Further details of the site inspection are included in Section 4, Findings of the 2001 Condition Assessment.

As yet no plan for DuSable Park has been formalized and the schedule and nature of any development is not established. One of the determining factors will be the level of effort required to restore the site to a condition suitable for supporting a park development. This report presents a set of repairs and maintenance measures that are required to enhance safety before any public use of the parcel can be implemented. Details of the proposed repairs are presented in Section 5, Proposed Repairs. In addition to the recommended repairs, cost estimates for the repairs and maintenance measures have been prepared. Details are presented in Section 6, Cost Estimates.

An engineering evaluation of the existing wall, of potential stabilization measures and of a schematic development scenario was also performed. This analysis was performed by developing a set of baseline design parameters and comparing increases (or decreases) in the values for the different cases. Further details of the engineering evaluation are

included in Section 7, Engineering Evaluation. Section 8, Summary, Recommendations and Conclusions completes the report.

Detailed breakdowns of the cost estimates are included in Appendix A, and results of a life-cycle cost analysis comparing partial or complete wall replacement is included as Appendix B. Details of the Engineering Evaluation is included as Appendix B.

2.0 SITE DESCRIPTION

The site covers an area of approximately 3.5 acres at the mouth of the Chicago River. The site is bounded on three sides by water, the Chicago River to the south and east, and Ogden Slip to the north. The western boundary of the study site is defined by Lake Shore Drive. Exhibits 1 and 2 show the project location and a site plan. The total length of the river wall around the site is approximately 1,100 lineal feet. Currently there are no above ground structures on the property. A more detailed description of the history and previous uses can be found in Harza's 1997 report, which drew heavily from a report titled "Environmental Reconnaissance" prepared by STS Consultants for the Chicago Dock and Canal Trust, 1989. At the time of the 1997 report efforts were made to obtain record drawings of the existing sheet pile river wall, but without success. Similar efforts in 2000/2001 have also been unsuccessful.

The geotechnical conditions, as described in the 1997 report (based on previous subsurface exploration at neighboring locations), indicate that the site comprises: dense silty clay overlain by medium stiff clay, overlain by soft clay, with silty sand fill materials comprising the upper layer. More detailed geotechnical information can be found in the 1997 report and the material referenced in that report.

The Metropolitan Water Reclamation District (MWRD) of Greater Chicago operates sluice gates located close to the project site that regulate the Chicago River water levels with respect to Lake Michigan water levels. MWRD keeps records of the river water levels at the Chicago Lock, which is to the east of the project site. Based on conversations with staff of MWRD, the Chicago River water level is generally maintained between -2.0 and -0.5 feet Chicago City Datum (CCD). Subsequent to extreme rainfall events the water level in the river rises. Over the past 32 years the water level has exceeded +3.0 ft. CCD on two occasions. The highest recorded water level is reported as +4.1 ft. CCD, which occurred during July 1996.

The South Wall of the project site constitutes the north bank of the Main Branch of the Chicago River. According to the National Oceanic and Atmospheric Administration's (NOAA) navigation map of the Main Branch of the Chicago River channel is maintained at a depth of 21 feet at mid-channel. The main branch in the vicinity of the project site forms a part of the Chicago Harbor, which falls under the jurisdiction of the U.S. Army

Corps of Engineers. The depth indicated on the navigation chart in the vicinity of the East Wall and the North Wall varies between approximately 15 and 19 feet. More detailed information including the water depth at the sheet pile, the depth of soft material at the sheet pile toe and the approximate slope of the river bed perpendicular to the sheet pile wall can be found in the 1997 report. No measurements of water depth were made as part of this present study.

The site plan (Exhibit 2) has been prepared based on a 1994 topographic survey performed by the Chicago Park District. No survey measurements were made as part of this study. However, the general topography of the site resembles that indicated on the 1994 survey. In general the ground surface slopes uniformly upwards away from each of the three river walls. The elevation of the top of each wall is approximately +5.0, and the high points on the site are at approximately +22.0.

3.0 SUMMARY OF PREVIOUS CONDITION ASSESSMENT

In 1997 the entire river wall was visually inspected both above and below the water surface to document the condition of the wall, and to identify defects or conditions, which could adversely affect the integrity of the wall. A systematic inspection program for collecting and documenting the inspection data was developed. This included division of the wall into quadrants using field established station points, the development of inspection procedures and documentation sheets for both the surface and underwater inspections, and a complete review of the safety procedures and practices to be employed during the assorted field inspections.

The inspection carried out in 1997 concluded that the condition of the river wall was good. The visible portions of the sheet piles and the protruding ends of the tie rods did not appear to be in need of major rehabilitation. Local damage was reported at several locations. The 1997 report surmised that major rehabilitation and/or replacement of the entire wall was unwarranted at that time.

The defects and deterioration observed in 1997 included denting, puncturing and other damage to the sheet piles presumably from vessel collisions, intermittent corrosion, pockets of material loss immediately behind the sheet piles, bulging of a portion of the north wall approximately 8" to 12" out of alignment at the top of the sheet piles. In addition the channel cap placed along the top of the sheet piles was misaligned or missing in several places. The river wall at the southeast corner of the site was observed to be lower than at the other portions of the wall, with some doubt as to the presence of tie rods and the possible use of a different sheet pile section.

4.0 FINDINGS OF 2001 CONDITION ASSESSMENT

4.1 General Conditions

The current inspection was carried out on January 29, 2001. Air temperature was above freezing but up to three inches of snow cover was present. The inspection revealed that conditions were substantially similar to those described in the 1997 report.

4.2 Specific Conditions

4.2.1 South Wall

The majority of the south wall appears to be in generally good condition with the exception of a couple of severely damaged individual piles at around the midpoint of the wall. Since this wall forms the north bank of the Chicago River navigation channel it is more exposed to the potential for damage due to vessel collision than other portions of the wall. It is hypothesized that the individual pile damage along this wall has been caused by such collisions. In addition, this wall is known to have been used in the past as a mooring location for barges. A typical repair detail for these conditions has been developed and is described in Section 5. A more detailed survey from the waterside is needed to locate and size the complete extent of such damage.

4.2.2 South East Corner

The south east corner of the site was the most difficult to inspect due to the presence of large timbers across the top of the wall. In addition, facing timbers on the riverside of the wall prevented the inspection of protruding tie rods and other features. These same conditions were reported in the 1997 inspection. It appears that the south and east portions of the wall comprising this corner may have undergone some lateral movement. It appears that a more substantial repair may be required in this vicinity. A suggested repair detail has been developed and is described in Section 5. It is hypothesized that a contributing factor to the deterioration of this portion of the wall is the non-uniform stress concentrations and 3-dimensional soil-structure interaction that takes place at a 90-degree corner.

4.2.3 East Wall

The majority of the east wall appears to be in good condition. The pockets of material loss reported in 1997 were still evident, but there did not appear to be any significant increase in the size or extent of the holes. It is postulated that these holes may have been developed by a felled tree. No major rehabilitation of the east wall is required.

4.2.4 North East Corner

The sheeting comprising the northeast corner appeared to be in good condition and well aligned. The channel cap, however, showed signs of distress including horizontal separation of distinct portions of the cap and damage to bolts connecting the cap to the sheet piles. It is not clear if the distortion to the channel cap is indicative of movement of the supporting sheet piles, or has been caused by another action, possibly the surrounding vegetation. (In other segments of the site the channel cap has been clearly displaced by the action of vegetation.) Since there is no apparent defect in the wall, no major rehabilitation is suggested for this portion of the wall, however continued monitoring and observation is recommended.

4.2.5 North Wall

There is significant deterioration on portions of the north wall, including a section of wall that is bulging and several areas of pronounced corrosion. The conditions, as visible from the above ground inspection, do not appear to have worsened significantly from the time of the previous inspection. A suggested repair detail has been developed and is described in Section 5.

4.3 Future Inspections

Conditions of the DuSable Park River Wall appear to be substantially similar to those reported in 1997. To provide a further level of detail, additional inspection of the existing tie rods could also be performed by excavating test pits. The nature of the anchor wall or deadman could be performed as well as evaluation of the tie rods for signs of deterioration. Non-destructive measurement techniques could also be employed to quantify the extent of corrosion at particular locations.

5.0 PROPOSED REPAIRS

5.1 Introduction

This section describes repairs that are recommended for implementation before any development of the property opens the site to public use. The recommended repairs have been developed under the assumption that the topography of the site remains essentially the same as the current conditions, and that no structures are built on the site. Section 7 of this report describes an engineering evaluation of the river wall under various development scenarios, some of which increase loads on the river wall. The addition of significant load to the wall will result in more extensive repairs being required.

As a result of the most recent inspection a list of proposed repairs has been developed. The descriptions that follow are general in nature. The repairs can be divided into three main groups; wall replacement, wall stabilization and patching. Wall replacement refers to the removal of an entire segment of the existing wall and the installation of a new wall segment. Wall stabilization refers to the installation of additional support structures to relieve a portion of the load from the existing wall and to bring the existing wall into better alignment. Patching refers to the installation of steel plates over existing piles that have been damaged or severely corroded. Wall patching is intended to substantially decelerate material loss from behind the wall and/or wall deterioration. A plan showing the approximate extent of each type of repairs is included as Exhibit 3. Exhibits 4, 5, and 6 show additional details of the proposed repairs. The extent of each type of repairs has been approximated based on the above ground visual inspection, and the dimensions and member sizes are approximate. In general typical member sizes from other similar projects have been selected. Approximate cost estimates for each of the repairs are presented in Section 6. In addition to the structural repairs described, a variety of maintenance items are recommended for the entire length of the river wall. A more complete description of each wall and the proposed repairs follows.

5.2 South Wall

Wall patching is recommended for certain individual or groups of sheet piles throughout the south wall. A typical detail is shown in Exhibit 6. The repair requires surface preparation of the sound steel surrounding the area to be patched and the welding of a bent plate over the damaged area. The most serious damage is located about 180 feet east

of Sta. 0+00. Several piles have been dented and require patching. A more extensive water side inspection is required to more precisely quantify the total area of patching required. The initial estimate is that approximately 100 square feet of patching will be required which corresponds to about 5% of the above water area of sheet pile.

5.3 Southeast Corner

The southeast corner of the property is in need of repairs. This portion of the wall is the most difficult to inspect because of the presence of large timbers. It is suggested that wall replacement be implemented at this corner. The approximate extent of the existing wall that requires replacement is 40 feet north and 40 feet west of the corner as shown on Exhibit 3. The proposed repair comprises the installation of a new wall and the demolition and removal of the existing wall. A section and detail of the proposed repair is shown on Exhibit 4. The repair detail comprises a new steel sheet pile wall, supported with batter piles as shown. At each end of the repair vertical H-piles are recommended to help tie the repair into the existing wall. A cost effective solution is to build a diagonal wall across the inside of the corner. Using this arrangement (and assuming that 40' x 40' corner is to be repaired) the replacement wall will be approximately 60 feet in length and will replace 80 feet of existing wall. This will result in the loss of about 800 square feet of the property (0.02 acres, less than 1%). Reconstruction of the existing corner with a diagonal wall is likely to be a preferable long-term solution and will better match the northeast corner as well as being about 20% cheaper than replacing the existing corner in-kind.

5.4 East Wall

The east wall of the site is in generally good condition and repairs are expected to be limited to patching of relatively small holes. The pockets of material loss adjacent to the wall should be filled with a granular backfill material (preferably a relatively lightweight fill). The initial estimate is that approximately 10 square feet of patching will be required which corresponds to less than 1% of the above water area of sheet pile.

5.5 Northeast Corner

No specific repairs are proposed for the northeast corner. However, as described in the previous section there is some evidence of distress to the channel cap that could possibly

have been caused by lateral movement of the wall. There is no obvious indication of major defects in the wall based on the visual inspection. Continued monitoring and observation is essential. If significant deterioration occurs a repair similar in nature and extent to those described for the southeast corner may be appropriate.

5.6 North Wall

A portion of the north wall is bulging northwards towards Ogden Slip. This condition was reported in the 1997 inspection and does not appear to be deteriorating rapidly. A repair detail is shown on Exhibit 5. The proposed repair entails driving new supporting piles landward of the bulging section that would act to relieve some of the load on the wall and could bring it back into alignment. Prior to installing the supporting piles the area immediately behind the wall would be excavated to an elevation below the tie rods, and broken or missing tie rods could be replaced. The extent of the repair is estimated to be about 30 feet. The existing condition of the tie rods (presently buried and not visible) may require a larger portion of the wall to be repaired.

Wall patching is recommended for certain individual or groups of sheet piles throughout the north wall, as previously described for the south wall. A typical detail is shown in Exhibit 6. The repair requires surface preparation of the sound steel surrounding the area to be patched and the welding of a bent plate over the damaged area. The most serious damage is located about 80 feet west of the northeast corner. A single pile has been cut and requires patching. A more extensive waterside inspection is required to more precisely quantify the total area of patching required. The initial estimate is that approximately 20 square feet of patching will be required which corresponds to about 1% of the above water area of sheet pile.

5.7 Recommended Maintenance Work

5.7.1 Fender Supports

The river wall has previously had a more extensive system of fenders attached to it. In many cases the fenders have been removed or deteriorated leaving the unsightly steel support frames and bolts. It is recommended that the remaining fenders, frames and bolts be removed and the resulting bolt holes in the sheet pile be plugged with an expansive epoxy grout. The purpose of the removal of the fenders is to discourage any mooring

adjacent to the river wall, which may induce additional lateral loads on the wall. Removing the supporting steel will improve the appearance of the wall and plugging bolt holes will prevent material loss or vegetation growth through the holes.

5.7.2 Channel Cap

The channel cap that covers the top of the sheet pile is damaged, misaligned or missing in places. It is recommended that the remaining caps be removed and that a new, uniform channel cap be installed throughout the site. While serving no major structural purpose, the new channel cap will provide more uniformity to the river edge and a more pleasing river wall. In its current, deteriorated state the channel cap presents a tripping hazard to the public.

5.8 Typical Construction Sequence for Repairs and Maintenance Work

A suggested construction sequence for the repairs and maintenance of the river wall is presented below:

1. Survey of the existing wall. This task includes detailed alignment survey and waterside inspection.
2. Demolition of existing features such as damaged steel cap, bolts, protruding fender frames, fenders, miscellaneous steel, and mooring posts and concrete foundations.
3. Clearing and grubbing of a swath of land around the perimeter of the park (about 20 feet wide) and at the areas of major repair.
4. Excavation of fill materials behind the existing wall at the southeast corner and along the north wall.
5. Removal of existing steel sheet pile, walers, tie rods at the southeast corner to the dredge line. (This activity will be required to avoid creating any navigation hazards in the Chicago River channel.)
6. Drive batter piles and vertical piles at the southeast corner and along the portions of the north wall identified for repair.
7. Install new steel waler to driven piles.
8. Drive new steel sheet piles at the southeast corner.
9. Make all connections between the new support piles and the steel sheet piles.
10. Prepare surfaces of the existing steel sheet pile to receive the patching.

11. Install the new steel plate to patch the damaged and/or corroded sheet piles.
12. Plug bolt holes.
13. Install new channel cap.
14. Backfill excavated and existing holes behind the sheet pile, leaving the appropriate grade for the proposed landscaping treatment.

6.0 COST ESTIMATES

6.1 Introduction

The cost estimates presented in this section are intended to be at the conceptual level and should not be perceived as estimates of probable construction cost. Further engineering and geotechnical investigation is strongly recommended prior to finalizing the repair program. Two cost estimates are presented. The first covers the cost of implementing the recommended repairs as described in this report. A second estimate has been developed that encompasses a much larger scope of work including the entire replacement of the river wall.

6.2 Methodology

The cost estimates have been developed by estimating the various material quantities required to accomplish the repair tasks and concurrently estimating the corresponding unit price. Unit prices have been developed based on recent competitively bid projects of similar scope and through use of published data such as the Means estimating book. Estimates of items such as mobilization and temporary facilities have also been included. The estimated cost includes all of the work to repair and stabilize the river wall and to backfill excavated and existing holes. No attempt has been made to estimate the cost of further developing the site for safe public use.

6.3 Minimum Recommended Repairs

The estimated construction cost (at February 2001 price levels) of the recommended repairs is \$ 375,000. This estimate includes 25% contingency which is appropriate for the current phase of design. No estimate for engineering, construction management or other owner's costs are included in this estimate. The material quantities and the assumed unit prices for this estimate are included in Appendix A. The estimate has been prepared based on the assumption that all of the proposed repairs are carried out at the same time. The cost may be greater if the repairs are performed in distinct phases. Similarly, the cost estimate assumes that construction will take place from the land-side. Water-based construction would likely be more expensive and could increase the overall construction cost by up to 50%.

The most significant cost items are the installation of new steel sheet piling and associated support members. If subsequent investigation (e.g. the preparation of a test pit) reveals additional defects not currently visible the cost of the proposed repairs will increase.

In order to illustrate the comparative cost of the individual repairs, the total cost of the repairs has been subdivided into individual estimates for each part of the site. The assumption, however, is that all of the work will be carried out concurrently. Performing only a portion of the repairs may cause the costs to rise. The breakdown is tabulated below:

Location	Type of Repairs	Estimated Cost ¹
South Wall	Wall Patching	\$ 18,000
Southeast Corner	Wall Replacement	\$ 235,000
East Wall and Northeast Corner	Wall Patching	\$ 21,000
North Wall	Wall Stabilization (30 ft.) and Wall Patching	\$ 63,000
Common Items	Mobilization, Demobilization, Temporary Facilities and Demolition	\$ 38,000
Total		\$ 375,000

Table 6-1 Breakdown of Minimum Recommended Repairs by Location

6.4 Complete Replacement of River Wall

The estimated construction cost (at February 2001 price levels) of replacement of the entire river wall is \$ 2,500,000. This estimate includes 25% contingency, which is appropriate for the current phase of design. No estimates for engineering, construction management or other owner's costs are included in this estimate. The material quantities

¹ These cost estimates are based on the assumption that no significant new loads are applied to the river walls. Section 7 contains further discussion regarding the cost implications of load variations.

and the assumed unit prices for this estimate are included in Appendix A. The estimate has been prepared based on the assumption that the entire wall replacement is carried out at the same time. The cost may be greater if the replacement is performed in distinct phases. Similarly, the cost estimate assumes that construction will take place from the land-side. Water-based construction would likely be more expensive and could increase the overall construction cost by up to 50%.

This estimate has been prepared for comparative purposes only. Feasibility level investigations to determine an acceptable alignment for the new wall are required, as well as more detailed geotechnical characterization and surveying, and regulatory review and approval.

6.5 Life-Cycle Cost Analysis

One of the major differences between the two scenarios for which cost estimates have been prepared is the future requirement for maintenance and rehabilitation. All other factors remaining equal, a new wall can be expected to have a longer useful life than the existing wall and require less extensive maintenance. In order to assess the relative merits of implementing a repair program or a complete replacement of the wall, a life-cycle cost analysis can be used to evaluate the Net Present Value (NPV) of an investment based on an assumed discount rate and a series of future payments. For each scenario, a series of future repair and maintenance activities has been assumed and the dollar cost (2001 prices) of those activities.

6.5.1 Minimum Recommended Repairs

For purposes of comparison the following schedule of regular maintenance and repairs has been assumed based on carrying out the minimum recommended repairs described above.

- Annual land-based visual inspection;
- Underwater inspection and minor wall patching every 2 years;
- A similar set of repairs as those recommended in this report every 5 years;
- Approximately half of the entire wall repaired or rehabilitated after 10 years; and
- The entire wall is replaced after 20 years.

After the wall is replaced, the same schedule of maintenance and repairs that is outlined below is assumed to be followed.

6.5.2 Complete Wall Replacement

For purposes of comparison the following schedule of regular maintenance and repairs has been assumed based on carrying out the complete wall replacement described above.

- Minimal visual inspection every 2 years;
- Underwater inspection every 5 years; and
- A similar set of repairs as the minimum recommended in this report after 30 years followed by the same inspection and maintenance program as described above.

6.5.3 Results

The preliminary life-cycle cost analysis was performed using discount rates of 6%, 8% and 12% and was extended over a time period of 50 years. The dollar values assumed for the different repair and maintenance scenarios are tabulated in Appendix A along with computed NPV values. The results of this preliminary analysis indicate that the minimum recommended repairs (followed by significantly more future maintenance expenditures) have lower NPV values than the entire wall replacement. As a result performing only the minimum repairs is a cost-effective course of action.

This analysis is intended to be illustrative in nature and does not account for the monetary value of the potential disruption to the park caused by more frequent repairs, nor does it assume any net increase in park revenues as a result of the completely replaced wall.

6.6 Evaluation of Advantages and Disadvantages of Partial or Complete Wall Rehabilitation

This report includes a series of measures, which could be implemented in order to allow the site to be developed as a public park, which would be cheaper than total wall replacement. Each alternative has several advantages and disadvantages. The following paragraphs are intended to present some of these potential advantages and disadvantages of each course of action.

6.6.1 Partial Wall Rehabilitation

Advantages:

- Less capital investment required before the determined use is implemented;
- Reduced construction time before the determined use is implemented; and
- Simpler regulatory approval process.

Disadvantages:

- Continued inspection and maintenance will be required;
- Proposed developments on the site are limited in the vicinity of the existing wall; and
- Future repairs may have to be performed from the water-side depending on the proposed site development.

6.6.2 Complete Wall Replacement

Advantages:

- Designed to current standards;
- Reduced regular inspection and maintenance schedules;
- Site-specific amenities (e.g. boat docking facilities) can be incorporated into the design;
- Less potential for disruption to the park during maintenance activities;
- Optimized to match park development; and
- More uniform appearance.

Disadvantages:

- Increased capital investment;
- Longer construction time before site can be developed; and
- More complex regulatory process.

7.0 ENGINEERING EVALUATION

7.1 Introduction

The 1997 report contains details of a structural analysis of the river wall that was performed to calculate the required depth of embedment needed for stability based on assumed parameter values describing the soil stratigraphy and properties, surface profiles and anchorage. Since the actual depth of embedment is unknown it is not possible to compute factors of safety for the river wall. The 1997 report concluded that while the wall “does not conform to current design philosophies and practices.....[it] is still standing and performing with the current loading conditions.” The report recommended that loads greater than those present at the time not be introduced.

It is possible that future development plans for the site may include alteration and/or re-grading of the site to meet functional or aesthetic objectives. The potential impact of such changes is not known. The purpose of this section of the report is to develop quantitative guidelines to assist future planning efforts. For example, it is possible that it may become desirable to modify the existing topography. Since the lateral load on the retaining wall is a function of the height of the fill in the vicinity of the wall, such modifications may lead to instability of the wall.

7.2 Methodology

The selected methodology utilized for this evaluation comprised the following steps:

1. Establish baseline parameters and conditions to be used as a benchmark for evaluating proposed site alterations;
2. Analyze the baseline conditions using the US Army Corps of Engineers' (USACE) CWLSHT computer program. For given input data, the program will estimate 3 key design parameters: Depth of Embedment, Maximum Bending Moment and Anchor Force². The results of the baseline case become the benchmark against which all subsequent results are compared.³

² Depth of Embedment is used to determine the tip elevation to which the sheet pile should be driven, Maximum Bending Moment is used to select the sheet pile section to be used for the wall, and the Anchor

3. Input data to describe alternative cases including the introduction of temporary construction loads, various re-grading alternatives and the influence of potentially stabilizing (or load reducing) modifications are collected and analyzed. For an individual parameter (e.g. magnitude of construction load), a range of values can be input to obtain an indication of the sensitivity of the analysis to that individual parameter.
4. The results of these cases (Depth of Embedment, Maximum Bending Moment and Anchor Force) are compared with the baseline case and used to determine the percentage increase (or decrease) in the parameters. This provides a quantitative scale to assess the potential impact of each alternative. In the tabulated results presented throughout this section negative values of variation indicate a condition that lessens the design parameters and equates to an increased factor of safety between the particular case and the baseline case. Positive values of variation indicate a condition that increases the design parameters and equates to a decreased factor of safety between the particular case and the baseline case.
5. Since the existing topography perpendicular to each of the walls and the potential modifications in the vicinity of each of the walls are different a baseline case has been developed for each wall (North Wall, East Wall and South Wall).

Descriptions of the cases and the results of the analyses are presented in the following sections. For each case the general trend of either increasing (or decreasing) the design parameters is the most significant result. The absolute magnitude of the increase (or decrease) is less reliable due to the uncertainty associated with the input parameters as discussed above.

Appendix A contains additional information about the model output including graphical depictions of the results.

Force is used to determine the size and spacing of the anchorage system, and the dimensions of other components such as the bolted connections.

³ In this report, the absolute numerical value of the three computed parameters is disregarded since there is substantial uncertainty regarding the existing conditions. The City of Chicago, Department of Transportation and the US Army Corps of Engineers were contacted, but neither agency had any available record drawings.

7.3 Study Cases

The following sections describe the parameters and conditions assumed in each of the study cases. In general the cases that have been investigated can be divided into two broad categories; sensitivity analyses and proposed condition analyses.

The sensitivity analyses investigate the variation in wall design parameters based on the change of a single input parameter:

1. Replacement of existing fill with lightweight fill material;
2. Application of surcharge at the toe of the structure;
3. Lowering of the top of wall elevation; and
4. Application of temporary construction loads.

The proposed condition analyses investigate the variation in wall design parameters based on a hypothetical development scenario⁴.

1. Re-grading of the site to facilitate a public park with connectivity to the mid-level of Lake Shore Drive.

7.3.1 Baseline Case

The baseline case assumes a horizontal ground surface at the top of the wall. The subsurface stratigraphy and properties are taken from the 1997 report without edit. A diagram illustrating this condition is shown in Exhibit 7. For each wall the elevation of the ground surface has been estimated from a 1994 topographical survey performed for the Park District. The following top of wall elevations were used in this study:

North Wall:	+5.7 feet
East Wall:	+4.9 feet
South Wall:	+5.0 feet

⁴ A conceptual scheme developed by others has been used as prototypes. The use of this particular scheme in this analysis is for illustrative purposes only, and in no way should be interpreted as a recommendation from Harza or as indicative of the Chicago Park District's intentions for the site.

7.3.2 Existing Conditions

The existing conditions cases are the same as the baseline cases with the exception that they utilize representative sloping ground surfaces obtained from the 1994 topographical survey instead of the horizontal ground surface. Cross sections for each wall are shown in Exhibit 8.

Results obtained are tabulated below:

EXISTING CONDITIONS	% Variation from Baseline Case		
Parameter	North Wall	East Wall	South Wall
Embedment Depth	9 %	11 %	2 %
Bending Moment	5 %	7 %	1 %
Anchor Force	4 %	6 %	1 %

Table 7-1 Comparison Between Existing Conditions and Baseline Case

The positive values in Table 1 indicate that the actual ground surface (which slopes upwards away from the wall) has a minor adverse impact on the wall, as compared with the baseline case which assumes a horizontal ground surface.

7.3.3 Use of Lightweight Fill

For this case the landside fill is assumed to be replaced by a lightweight fill (e.g. blast furnace slag), which will reduce the lateral load placed on the wall. Two different values for the density of fill were investigated to illustrate sensitivity. This case was investigated to determine if the removal and replacement of the existing fill could be a feasible option for reducing the load on the wall in lieu of total replacement of the wall. Fill replacement was assumed to extend to elevation to the dredgeline (river bed).

Results obtained are tabulated below:

LIGHTWEIGHT FILL	% Variation from Baseline Case					
	North Wall		East Wall		South Wall	
Parameter	100 pcf	85 pcf	100 pcf	85 pcf	100 pcf	85 pcf
Embedment Depth	- 23 %	- 45 %	- 24 %	- 46 %	- 24 %	- 45 %
Bending Moment	- 16 %	- 33 %	- 17 %	- 33 %	- 17 %	- 33 %
Anchor Force	-15 %	- 30 %	- 15 %	- 31 %	- 15 %	- 31 %

Table 7-2. Comparison Between Lightweight Fill and Baseline Case

The negative values in Table 2 indicate that this alternative could potentially relieve the load on the wall. The extent of the fill replacement landward was not considered in this analysis, neither has the feasibility of performing this work been evaluated. The integrity of the tie rods and the anchorage would have to be maintained throughout the excavation and fill replacement. A conceptual-level cost estimate (at February 2001 price levels, with 25% contingency) for this work is approximately \$ 1,000 per linear foot. A lesser volume of fill replacement would be cheaper, but would have a lesser load-reducing impact on the wall.

7.3.4 Addition of Surcharge at the Toe of the Structure

For this case stone surcharge is assumed to be placed on the riverside, which will serve to reduce the required depth of embedment of the sheet piles. Two different values for the surcharge (representing different volumes of stone placed at the toe) were investigated to illustrate sensitivity. This case was investigated to determine if the addition of surcharge could be a feasible option for stabilizing the wall in lieu of total replacement of the wall. Surcharge was assumed to be applied over a 15-foot wide strip adjacent to the wall. Extending the surcharge further into the river may interfere with navigation along the waterway. Discussions with the appropriate regulatory agencies would be required to determine if this is a feasible measure.

Results obtained are tabulated below:

TOE SURCHARGE	% Variation from Baseline Case					
Parameter	North Wall		East Wall		South Wall	
	2 ft.	5 ft.	2 ft.	5 ft.	2 ft.	5 ft.
Embedment Depth	- 14 %	- 31 %	- 14 %	- 32 %	-13 %	- 29 %
Bending Moment	0 %	0 %	0 %	0 %	0 %	0 %
Anchor Force	0 %	0 %	0 %	0 %	0 %	0 %

Table 7-3. Comparison Between Toe Surcharge and Baseline Case

The negative values for embedment depth in Table 3 indicate that this alternative could potentially reduce the required penetration of the sheet pile wall. The other design parameters are not impacted by the addition of toe surcharge. A conceptual-level cost estimate (at February 2001 price levels, with 25% contingency) for this work is approximately \$ 400 per linear foot.

7.3.5 Lowering of the Top of Wall

For this case it is assumed that the top of the river wall be lowered by cutting the sheet piles and removing a layer of the existing backfill material. Since the anchorage system (tie rods) is located about 5 feet below the top of wall there is an opportunity to reduce the wall height by up to approximately 3 feet. The edge of the property would have to be designed to accommodate natural water level fluctuations, and possible overtopping by vessel wake. In this analysis the ground surface is assumed to be horizontal.

Results obtained are tabulated below:

WALL LOWERING	% Variation from Baseline Case					
Parameter	North Wall		East Wall		South Wall	
	EL. +4.0	EL. +2.0	EL. +4.0	EL. +2.0	EL. +4.0	EL. +2.0
Embedment Depth	- 13 %	- 31 %	- 6 %	- 25 %	- 9 %	- 27 %
Bending Moment	- 13 %	- 30 %	- 8 %	- 26 %	- 8 %	- 26 %
Anchor Force	- 23 %	- 46 %	- 13 %	- 39 %	- 15 %	- 40 %

Table 7-4. Comparison Between Lower Wall and Baseline Case

The negative values in Table 4 indicate that this alternative could potentially relieve the loads on the wall. A conceptual-level cost estimate (at February 2001 price levels, with 25% contingency) for this work is approximately \$ 500 per linear foot.

Reducing the wall elevation may allow the development of a “softer” river edge treatment, with the addition of wetland type plantings. It would be technically feasible, but potentially expensive, to replace the existing anchors with a support system that would allow the top of the wall to be lowered to river level or below. The regulatory impact, and cost, of such a development is beyond the scope of this report, but would require investigation.

7.3.6 Temporary Construction Loads

For this case a uniform load is assumed to be placed on the landside, which will serve to increase the lateral load on the wall. Two different values for the load (representing different sizes of equipment) were investigated to illustrate sensitivity. In each case the load was assumed to be distributed over a 20-foot strip adjacent to the top of the wall. This case was investigated to determine if the staging of construction equipment close to the wall could have a detrimental impact on the wall.

Results obtained are tabulated below:

CONSTRUCTION LOADS	% Variation from Baseline Case					
	North Wall		East Wall		South Wall	
	250 psf	500 psf	250 psf	500 psf	250 psf	500 psf
Embedment Depth	28 %	190 %	24 %	81 %	21 %	64 %
Bending Moment	33 %	139 %	23 %	78 %	27 %	82 %
Anchor Force	30 %	61 %	32 %	64 %	32 %	64 %

Table 7-5. Comparison Between Construction Loads and Baseline Cases

The positive values in Table 5 illustrate the potentially dangerous impacts to the wall if heavy construction equipment is operated close to the wall. Specific weight restrictions are nearly impossible to determine due to the different load distribution characteristics of different equipment and the time-dependency of the soil response. In addition, since the parameter values are non-linearly related to the construction loadings, case specific analyses should be performed before allowing construction equipment onto the site and the responsibility of any construction contractor to maintain the integrity of the wall must be spelled out in any contract specifications. The impacts of the construction loads can be mitigated by the use of mats to spread loads over larger areas and by keeping large loads further away from the wall. Depending on the nature of the work being performed, temporary bracing of portions of the wall may also be considered.

7.3.7 Park Development

To investigate the potential impacts of a proposed park development (Exhibit 9, 10) each wall was analyzed based on the following presumed modifications:

1. Re-grading of the site as shown on the possible park development provided to Harza.

2. Introduction of loads associated with public art as shown on the possible park development provided to Harza.

Results obtained are tabulated below:

PROPOSED PARK	% Variation from Baseline Case		
Parameter	North Wall	East Wall	South Wall
Embedment Depth	229 %	0 %	10 %
Bending Moment	854 %	0 %	3 %
Anchor Force	11 %	0 %	1 %

Table 7-6. Comparison Between Proposed Park and Baseline Conditions

The results obtained for this case indicate that the proposed park development appears to have no measurable impact on the east wall and a only a minor impact to the south wall. However, the impact to the north wall is clearly significant, and changes to the proposal and/or additional stabilization measures should be investigated. The relationships among wall fill height, fill location (distance from the river wall) and impacts to the wall are non-linear. Moving the proposed retaining wall landward from the river wall, and/or reducing the height of the retaining wall would reduce the potential impacts. Concurrent design of the park development and river wall improvements provide an opportunity for optimization of both structures.

In Section 6 the cost of replacement of the entire wall was estimated to be on the order of \$2.5 million, which represents about \$2,300 per linear foot of wall. Based on the results obtained above, implementation of the proposed park development would require the North Wall to be rebuilt with a significantly larger steel sheet pile section embedded further into the ground with anchors spaced at more frequent intervals. A preliminary estimate of the additional cost of such a wall section is between \$2,000 and \$2,800 per linear foot. Assuming that the larger wall section would be required for a length of between 200 feet and 350 feet results in additional costs of between \$400,000 and

\$1,000,000 to replace the North Wall. This would drive the cost of entire wall replacement to between \$2.9 million and \$3.5 million. The cost of repairing the East and South walls to the extent described in Section 6.3 and upgrading the North Wall to support the re-grading is estimated to be between \$1.2 million and \$2.1 million

If the proposed development is implemented as shown, the additional cost required to replace the North Wall could be mitigated by designing the new retaining wall structure to have its own independent foundation. Alternatively mechanically stabilized soil techniques could be used to reduce the lateral loads applied to the river wall. In addition to the potential impacts to the river wall, addition of significant surcharge to an area of the park may cause settlement of the underlying soils. While design of the park features is outside the scope of this supplemental report it is noted that considerable efficiencies could be obtained by concurrent detailed design of the park and river wall improvements.

8.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary

A summary of the inspections, analyses and findings of this study are as follows:

1. A review of previous studies performed pertaining to the proposed DuSable Park site was conducted. The primary resource was a 1997 report prepared by Harza documenting a surface and underwater inspection and condition assessment;
2. A condition assessment of the existing river wall structures was conducted. The inspection consisted of examining only the parts of structures above the waterline from the landside. No underwater inspection, or water-based inspection of the site was performed;
3. A primary finding of the 1997 report was that the river wall in its existing condition would likely not meet current design guidelines. However, since the wall has had a satisfactory service life there is no reason to assume that the wall will not continue to perform adequately as long as no additional loads are introduced;
4. The condition assessment performed as part of this study did not reveal any evidence that the previous conclusion does not still apply;
5. The condition assessment found that the southeast corner of the site and a portion of the north wall are in need of the most extensive repairs. The majority of the wall is in relatively good condition;
6. A suite of suggested repairs has been developed. The repairs consist of three distinct types: patching of damaged and/or corroded sheet piles, installation of support piles to realign existing piles and total replacement of a portion of the wall;
7. Conceptual level details of each type of repair have been prepared, and an estimate made of the extent of each repair type;

8. A cost estimate for the construction of the river wall repairs have been developed, along with an estimate for the complete replacement of the river wall. The conceptual-level cost estimates are in February 2001 dollars and are subject to cost escalation and inflation.
9. The estimated cost of the minimum recommended repairs to the river wall are \$375,000. The estimated cost of replacement of the entire wall is \$2,500,000;
10. A life-cycle cost analysis indicates that the Net Present Value (NPV) of the proposed repairs is less than the NPV of the entire wall replacement (see Appendix A);
11. An engineering evaluation was performed of a proposed development scenario for the site. For comparison purposes key parameters regarding the design of the river wall were computed under existing conditions and under the proposed development scenario;
12. The proposed park development supplied by the Park District includes a new retaining located close to the existing north river wall. As shown in the conceptual design, this retaining wall will require substantial modifications to the existing river wall. A new wall in this location, designed to meet the requirements of the proposed grading may be twice as expensive (per linear foot) as a replacement wall designed to meet the requirements of the existing site grading; and
13. A preliminary estimate of the cost of replacing the entire wall to support the development as shown in the conceptual design is between \$2.9 million and \$3.5 million. Implementing the minimum recommended repairs for the East and South walls and upgrading the North wall to support the re-grading is estimated to be between \$1.2 million and \$2.1 million.

8.2 Conclusions

Conclusions based on the data analysis and evaluations presented in this report are as follows:

1. The DuSable Park river wall appears to be in substantially the same condition as was reported in 1997, the occasion of the most recent documented inspection;
2. The conclusion reached in the 1997 report that “minor rehabilitation is required if the operational/functional requirements and loads placed on the wall remain unchanged” is still justifiable at the present time;
3. If the existing wall is not replaced, development scenarios for DuSable Park that do not increase the lateral load on the existing river wall are recommended. However, development scenarios that increase the loading on the wall should not be automatically dismissed, but should include mitigative measures or wall strengthening measures;
4. While the three components of the river wall (South Wall, East Wall, and North Wall) are in relatively good condition, repairs ranging from wall patching to wall replacement for individual segments of the site are recommended prior to opening the site to public use;
5. Three stabilizing measures were investigated during the engineering evaluation. The percentage reduction in design parameters resulting from the stabilizing measures varied from 0% to 45%. Further investigation is required to verify whether any one of these options can be used individually or in combination to substantially offset modifications to the site;
6. Proposed development of the property which leaves the existing topography relatively unchanged within 30 feet of the river wall is unlikely to lead to major reconstruction of the wall being required;
7. Proposed development of the property which includes the construction of large fill-retaining structures close to the river wall will require major reconstruction of the river wall or the implementation of independent foundation treatments;
8. Future development will impact the ease with which future repairs can be carried out. Under the development scenario provided, access to the site may be restricted in the future, which may lead to water-side construction, which is generally more expensive.

8.3 Recommendations

Specific recommendations for the development of the site are listed below:

1. More detailed repair-specific geotechnical information is required before designs for the rehabilitation measures (and the associated costs) can be finalized;
2. If the existing wall is not replaced, or portions thereof, modifications to the site which involve elevating the existing ground surface in the vicinity of the river walls are not recommended. The appropriate setback distance is related to the proposed height change and should be evaluated on a case-by-case basis;
3. Construction of any development at the park should limit construction loads within 20 feet of the existing river walls;
4. No new lateral loads should be introduced to the river wall. Examples include the introduction of boat mooring locations and increasing the site elevation. If loading is increased then designs to account for this new loading should be developed;
5. Design of the site development proposals should be coordinated with the design of the river wall improvements to allow for the greatest level of optimization between the projects;
6. Regular inspection and maintenance of the river wall will be required under any development scenario. The frequency and level of detail of such inspections has will be dictated by the extent of the rehabilitation measures and the proposed uses.

REFERENCES

Harza Engineering Company, 1997, "DuSable Park Development; River Wall Condition Assessment Report", prepared for Johnson, Johnson & Roy, Inc.

STS Consultants Ltd., 1989, "Environmental Reconnaissance, E. North Water Street and Lake Shore Drive Chicago, Illinois" prepared for Chicago Dock and Canal Trust.

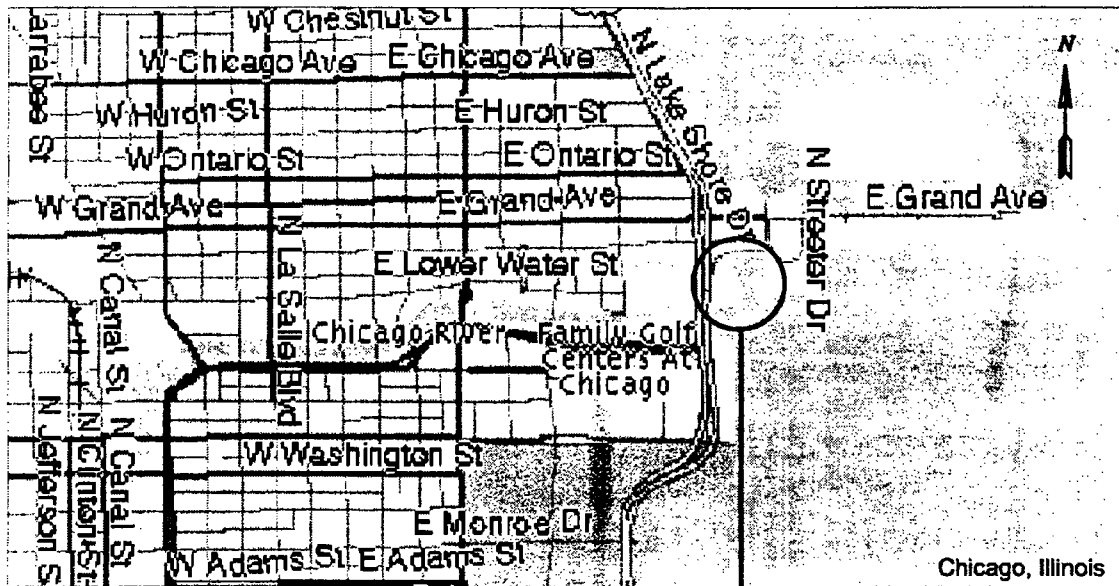
Chicago Park District, 1994, "DuSable Park" Topographic Survey.

U.S. Department of Commerce, 1996, National Oceanic and Atmospheric Administration Recreational Chart 14926.

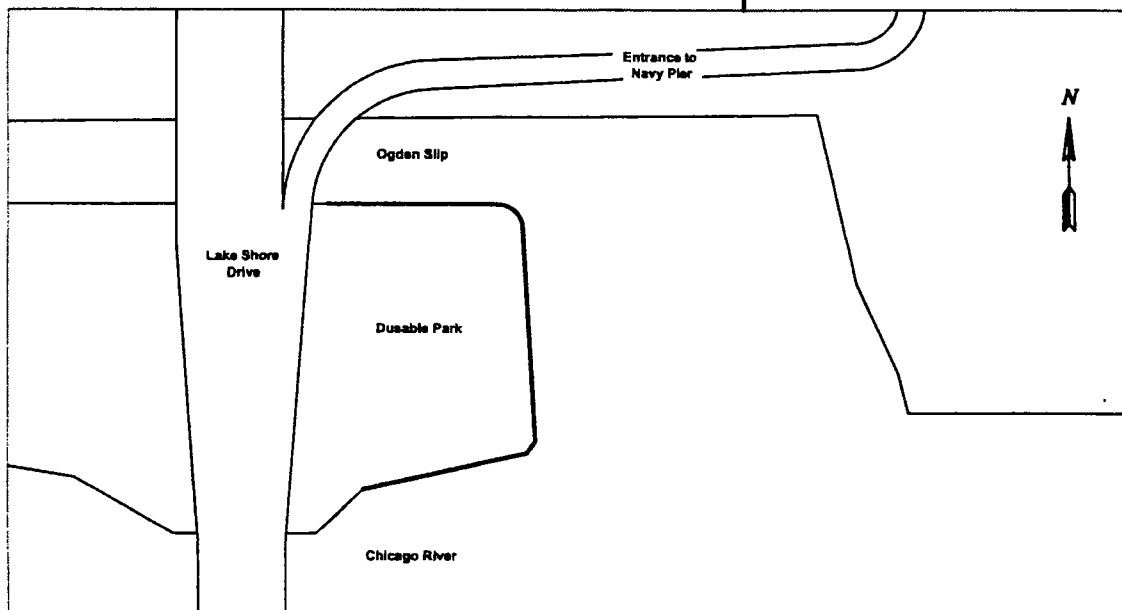
EXHIBITS

- EXHIBIT 1 PROJECT LOCATION
- EXHIBIT 2 SITE PLAN
- EXHIBIT 3 RECOMMENDED REPAIRS - PLAN
- EXHIBIT 4 SOUTHEAST CORNER WALL REPLACEMENT SECTION AND
DETAIL
- EXHIBIT 5 NORTH WALL STABILIZATION SECTION
- EXHIBIT 6 TYPICAL WALL PATCHING DETAIL
- EXHIBIT 7 ENGINEERING EVALUATION – BASELINE CONDITIONS
- EXHIBIT 8 EXISTING CONDITIONS - TOPOGRAPHY
- EXHIBIT 9 PARK DEVELOPMENT (PLAN VIEW)
- EXHIBIT 10 PARK DEVELOPMENT (SECTIONS)

EXHIBIT 1
Project Location



VICINITY MAP



LOCATION MAP

HARZA

DUSABLE PARK DEVELOPMENT
RIVER WALL CONDITION ASSESSMENT
FEBRUARY 2001

EXHIBIT 2

Site Plan

1994 Chicago Park District Survey



Lake Shore
Drive

Ogden Slip

Chicago River

10+00

9+00

8+00

7+40

7+40

7+07

7+07
7+00

8+00

5+00

4+00

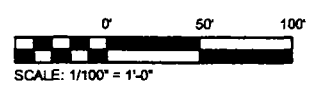
3+00
2+91

0+00

1+00

2+00

2+91

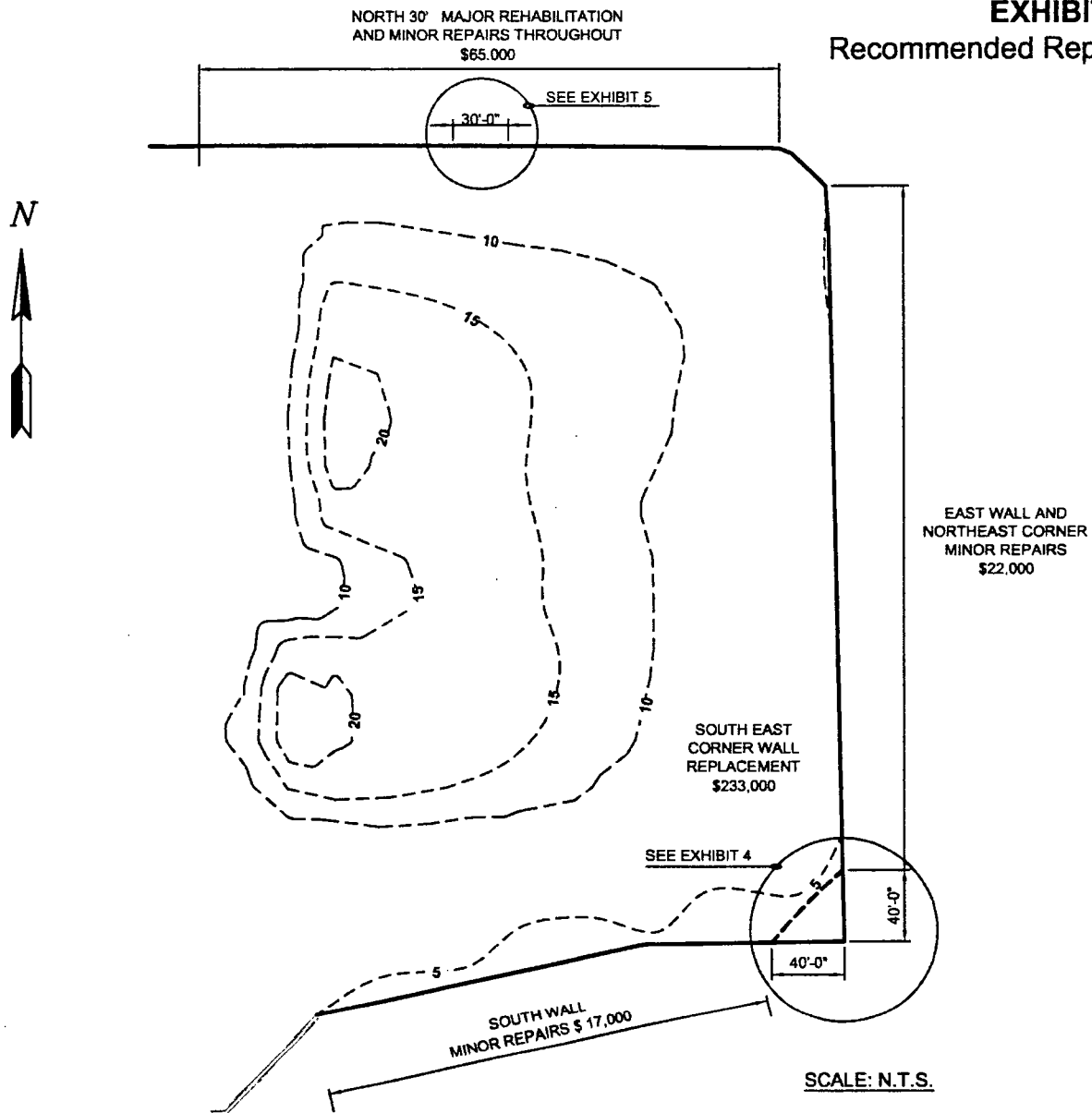


SITE SURVEY PLAN

HARZA

DUSABLE PARK DEVELOPMENT
RIVER WALL CONDITION ASSESSMENT
FEBRUARY 2001

EXHIBIT 3
Recommended Repairs



NOTES:

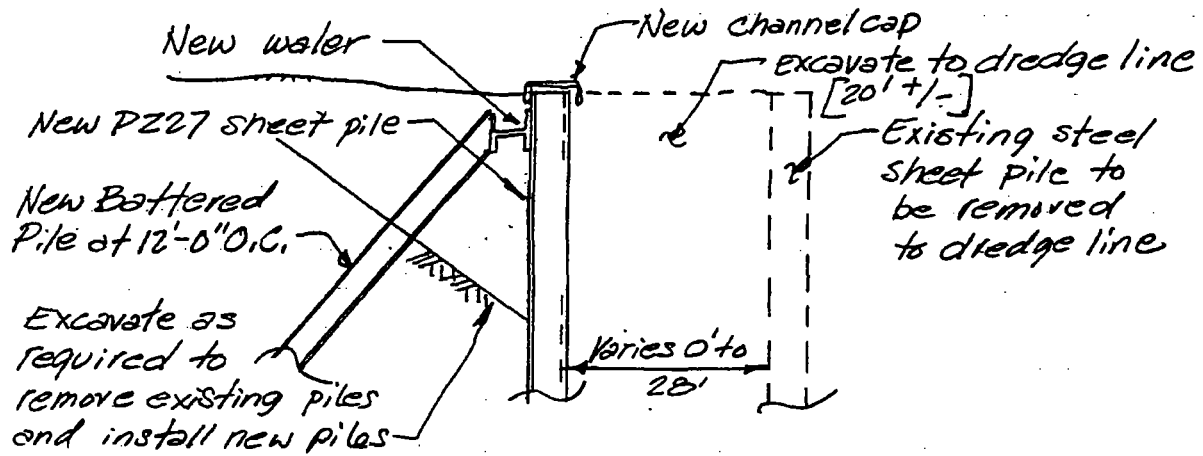
- I. All cost estimates are at February 2001 price levels and include 25% contingency.
- II. Mobilization, Demobilization, Temporary Facilities and Minor Demolition estimated to be \$38,000.
- III. Cost of repairs shown in this exhibit assume that no significant new load is added to the wall. Total cost of repairs shown is \$375,000.

HARZA

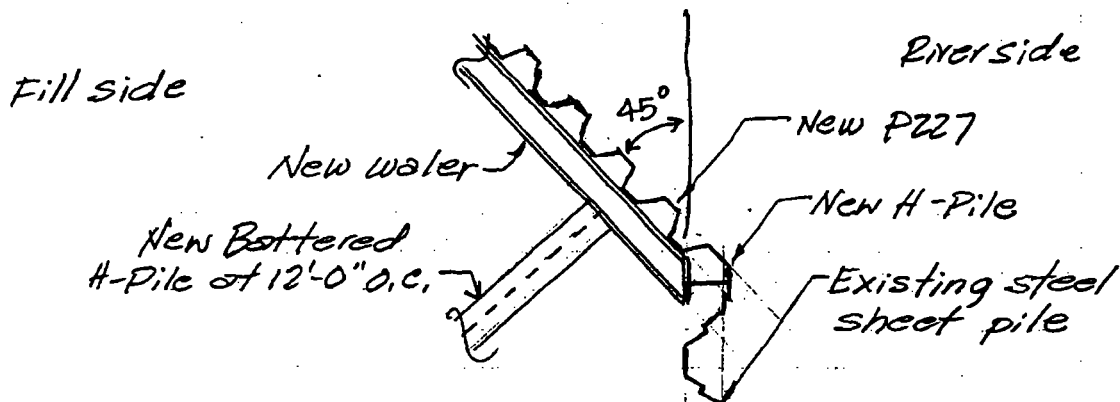
DUSABLE PARK DEVELOPMENT
RIVER WALL CONDITION ASSESSMENT
FEBRUARY 2001

EXHIBIT 4

Southeast Corner Wall Replacement Section and Detail



Proposed Repair for Southeast Corner
Typical Section

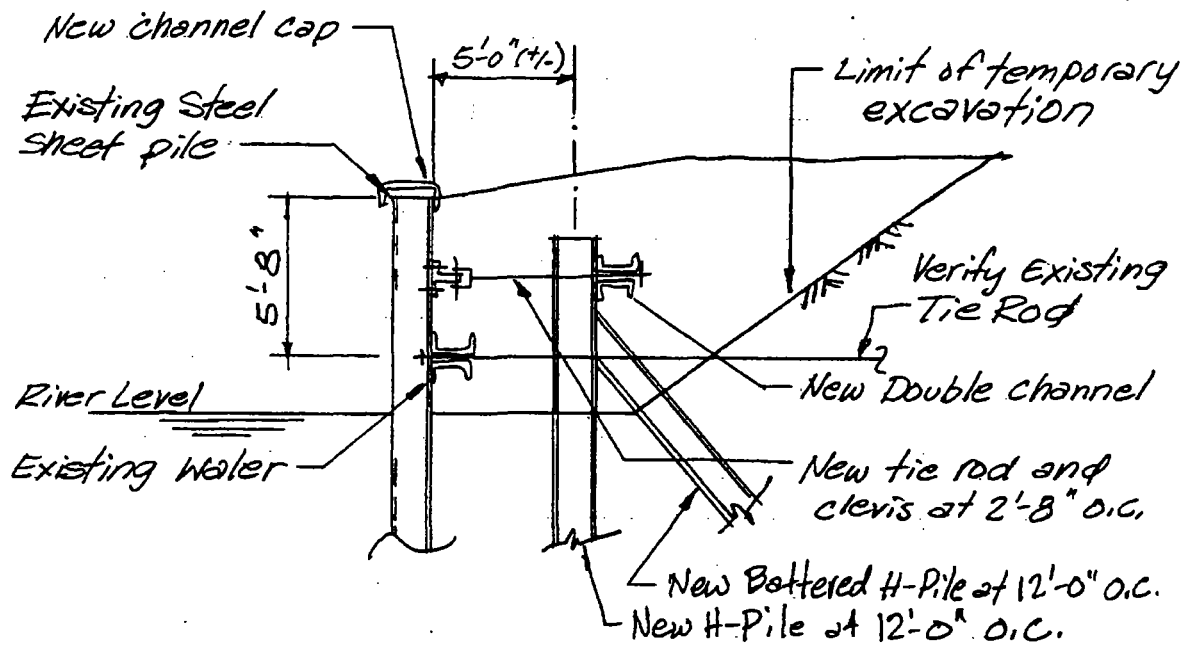


Proposed Repair for Southeast Corner
Typical End Detail

DUSABLE PARK DEVELOPMENT
RIVER WALL CONDITION ASSESSMENT
FEBRUARY 2001

HARZA

EXHIBIT 5
Proposed North Wall Stabilization Measures
Typical Section

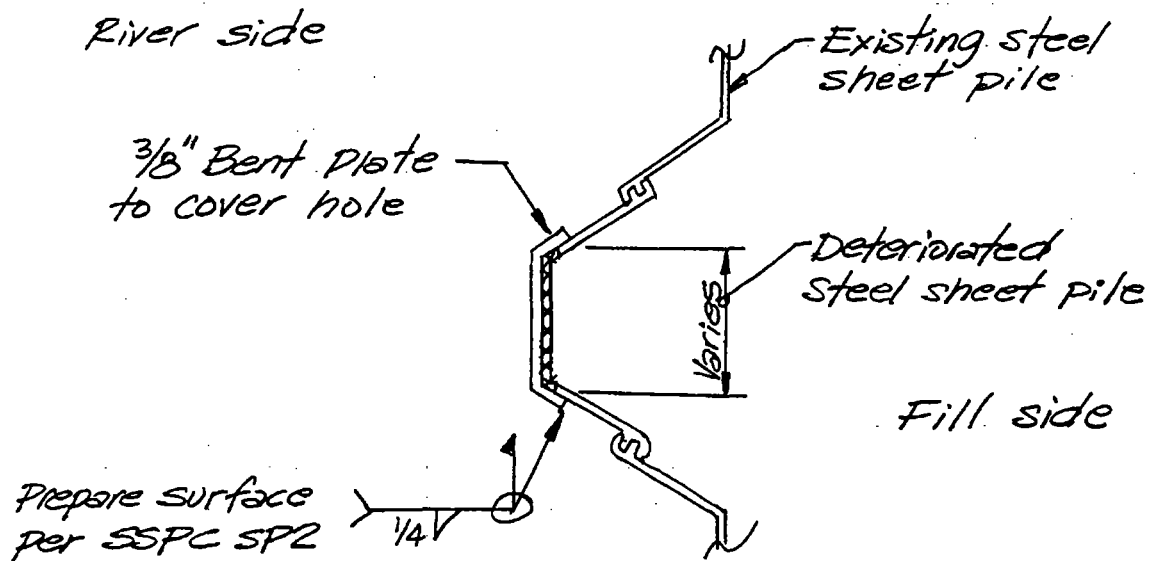


Proposed Repair for North Wall
Typical Section

DUSABLE PARK DEVELOPMENT
RIVER WALL CONDITION ASSESSMENT
FEBRUARY 2001

HARZA

EXHIBIT 6
Typical Wall Patching Detail



HARZA

DUSABLE PARK DEVELOPMENT
RIVER WALL CONDITION ASSESSMENT
FEBRUARY 2001

EXHIBIT 7
Engineering Evaluation
Baseline Conditions

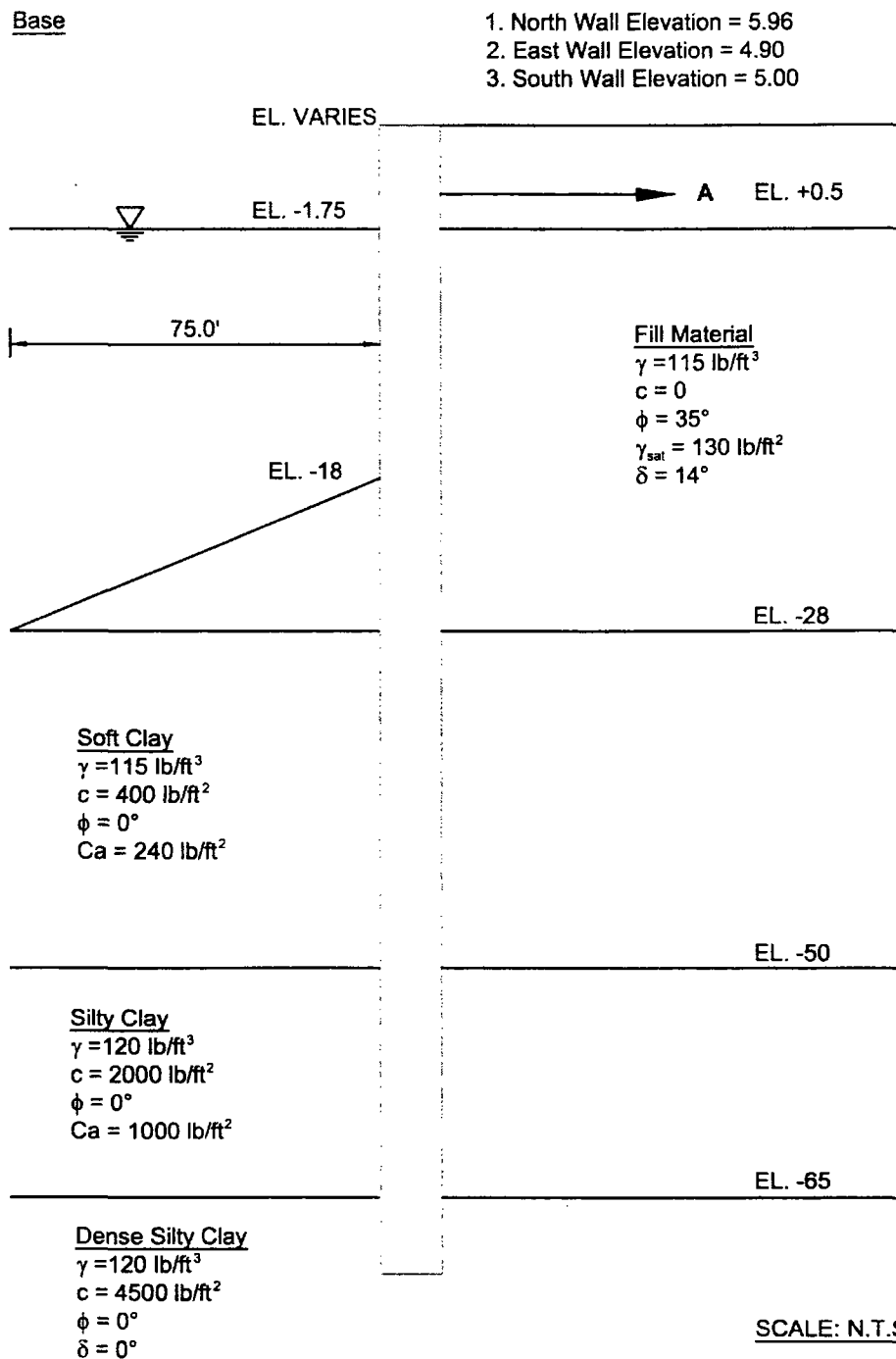
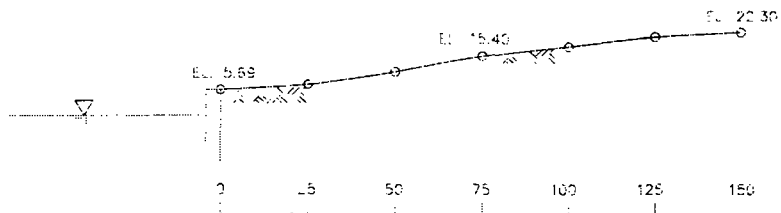
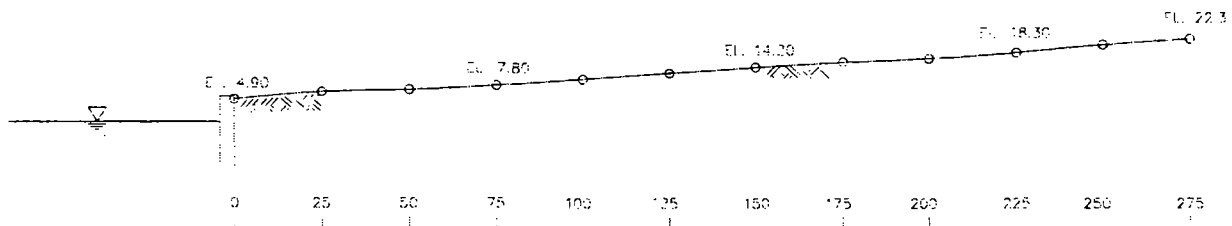


EXHIBIT 8
Engineering Evaluation
Existing Conditions

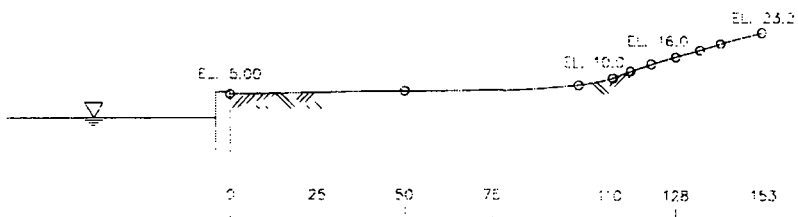
TYPICAL CROSS SECTIONS



NORTH WALL ELEVATION
SCALE: N.T.S.



EAST WALL ELEVATION
SCALE: N.T.S.



SOUTH WALL ELEVATION
SCALE: N.T.S.

EXHIBIT 10 PARK DEVELOPMENT (SECTIONS)
(COURTESY CHICAGO PARK DISTRICT)



CHICAGO
PARK
DISTRICT
425 East McFarlane Drive
Chicago, Illinois
60605

REVISIONS	DATE

APPROVED
PROJ. MGR.
DESIGNER
DRAWN
CHECKED
SCALE
DATE
SPEC. NO.
JOB NO.
SHEET INFORMATION

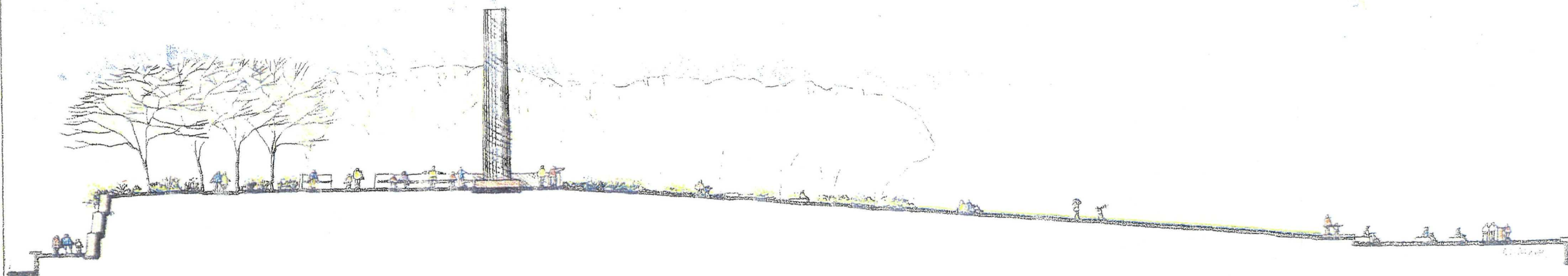
CONCEPTUAL PLAN
DUSABLE PARK
APRIL 22, 1999

PARK NO. PROJECT NO.
DRAWING NO.



LAKE SHORE DRIVE • PED. RAMP • DUSABLE SCULPTURE / OVERLOOK • STAIRWAY, NATURAL PLANTINGS • SIDEWALK • BOAT DOCKING

DUSABLE PARK • WEST-EAST ELEVATION



RETAINING WALL, PATH • SCULPTURE / OVERLOOK • FLOWERS / WOODLAND PLANTS / PATH • GRASS, INFORMAL RECREATION • SIDEWALK / SEATING • DUSABLE HISTORY

DUSABLE PARK • NORTH-SOUTH ELEVATION

APPENDIX A – COST ESTIMATES

DuSable Park River Wall Condition Assessment

Cost Estimate for Repairs

Item No.	Description	Quantity	Unit	Unit Cost	Cost
1	Mobilization/Demobilization	1	LS	\$15,000	\$15,000
2	Temporary Facilities	1	LS	\$10,000	\$10,000
3	Demolition	1	LS	\$5,000	\$5,000
4	Clearing and Grubbing	33000	SF	\$0.15	\$4,950
5	Excavation	2400	CY	\$12	\$28,800
6	Backfilling	1700	CY	\$15	\$25,500
7	Sheet Pile Removal	1800	SF	\$20	\$36,000
8	Steel Sheet Piles	3000	SF	\$24	\$72,000
9	Vertical HP Piles	400	LF	\$40	\$16,000
10	Batter HP Piles	940	LF	\$45	\$42,300
11	Wales	100	LF	\$50	\$5,000
12	Wall Patching	130	SF	\$35	\$4,550
13	Channel Cap	1100	LF	\$32	\$35,200
				Total	\$300,300
				Total w/25% contingency	\$375,000

NOTES:

1. Unit costs are estimated based on landside construction. Water based construction may significantly increase the costs.
2. Cost estimate assumes that all work will be performed as one contract at the same time.
3. Cost estimate is based on the assumption that there is no net increase in loading on the wall.

DuSable Park River Wall Condition Assessment

Cost Estimate for Entire Wall Replacement

Item No.	Description	Quantity	Unit	Unit Cost	Cost
1	Mobilization/Demobilization	1	LS	\$50,000	\$50,000
2	Temporary Facilities	1	LS	\$50,000	\$50,000
3	Demolition	1	LS	\$50,000	\$50,000
4	Clearing and Grubbing	33000	SF	\$0.15	\$4,950
5	Excavation	4000	CY	\$12	\$48,000
6	Backfilling	2400	CY	\$15	\$36,000
7	Sheet Pile Removal	5500	SF	\$20	\$110,000
8	Steel Sheet Piles	49500	SF	\$24	\$1,188,000
9	Vertical HP Piles	320	LF	\$40	\$12,800
10	Batter HP Piles	8000	LF	\$45	\$360,000
11	Wales	1100	LF	\$50	\$55,000
12	Wall Patching	0	SF	\$35	\$0
13	Channel Cap	1100	LF	\$32	\$35,200
				Total	\$1,999,950
				Total w/25% contingency	\$2,500,000

NOTES:

1. Unit costs are estimated based on landside construction. Water based construction may significantly increase the costs.
2. Cost estimate assumes that all work will be performed as one contract at the same time.
3. Cost estimate is based on the assumption that there is no net increase in loading on the wall.

APPENDIX B – LIFE-CYCLE COST ANALYSIS

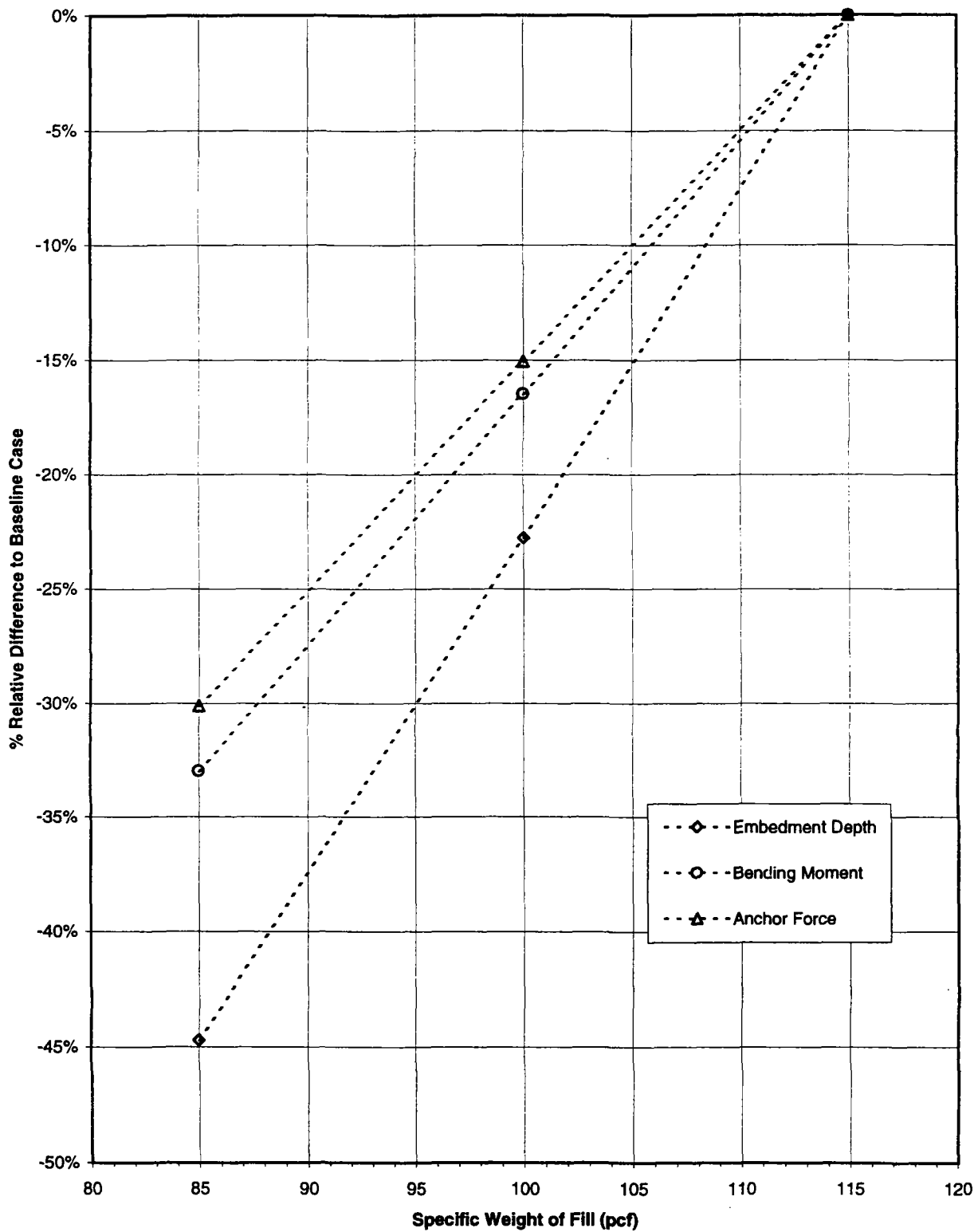
DuSable Park River Wall

Estimated Costs (2001) for Various Repair Rehabilitation & Operation and Maintenance Activities

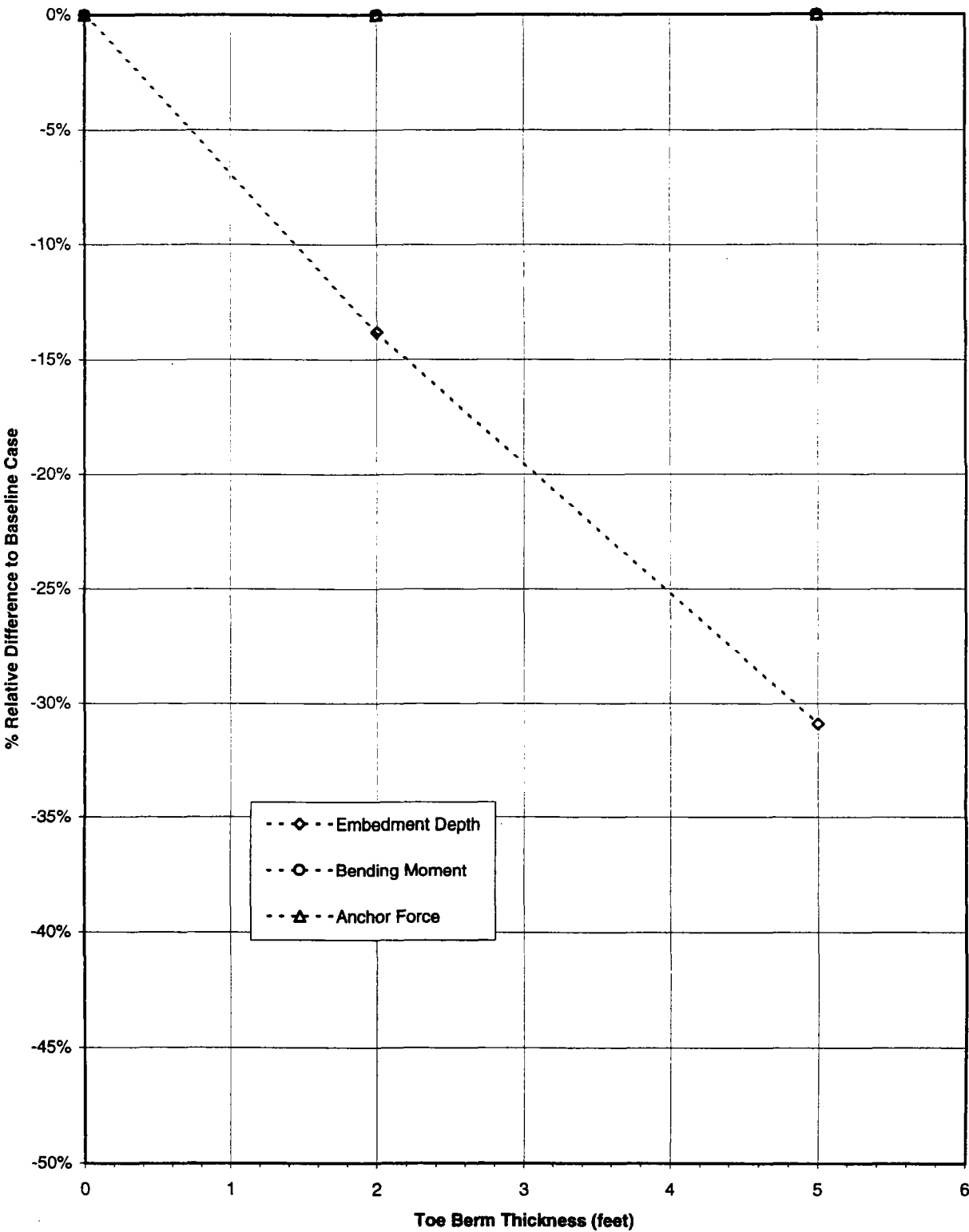
Minimum Repairs Alternative						Entire New Wall Alternative					
Year	Visual Insp.	Diver Insp.	Patching	Wall Repair & Replacement	Total	Visual Insp.	Diver Insp.	Patching	Wall Repair & Replacement	Total	
Initial Construction Cost Estimate (w/contingency)					\$375,000						\$2,500,000
1	\$7,500				\$7,500	\$1,920				\$1,920	
2	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
3	\$7,500				\$7,500	\$1,920				\$1,920	
4	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
5	\$7,500			\$375,000	\$382,500	\$1,920	\$5,000			\$6,920	
6	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
7	\$7,500				\$7,500	\$1,920				\$1,920	
8	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
9	\$7,500				\$7,500	\$1,920				\$1,920	
10	\$7,500	\$5,000		\$1,250,000	\$1,262,500		\$5,000			\$5,000	
11	\$7,500				\$7,500	\$1,920				\$1,920	
12	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
13	\$7,500				\$7,500	\$1,920				\$1,920	
14	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
15	\$7,500			\$375,000	\$382,500	\$1,920	\$5,000			\$6,920	
16	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
17	\$7,500				\$7,500	\$1,920				\$1,920	
18	\$7,500	\$5,000	\$25,000		\$37,500					\$0	
19	\$7,500				\$7,500	\$1,920				\$1,920	
20				\$2,500,000	\$2,500,000		\$5,000			\$5,000	
21	\$1,920				\$1,920	\$1,920				\$1,920	
22					\$0					\$0	
23	\$1,920				\$1,920	\$1,920				\$1,920	
24					\$0					\$0	
25	\$1,920	\$5,000			\$6,920	\$1,920	\$5,000			\$6,920	
26					\$0					\$0	
27	\$1,920				\$1,920	\$1,920				\$1,920	
28					\$0					\$0	
29	\$1,920				\$1,920	\$1,920				\$1,920	
30		\$5,000			\$5,000				\$375,000	\$375,000	
31	\$1,920				\$1,920	\$7,500				\$7,500	
32					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
33	\$1,920				\$1,920	\$7,500				\$7,500	
34					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
35	\$1,920	\$5,000			\$6,920	\$7,500			\$375,000	\$382,500	
36					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
37	\$1,920				\$1,920	\$7,500				\$7,500	
38					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
39	\$1,920				\$1,920	\$7,500				\$7,500	
40		\$5,000			\$5,000	\$7,500	\$5,000		\$1,250,000	\$1,262,500	
41	\$1,920				\$1,920	\$7,500				\$7,500	
42					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
43	\$1,920				\$1,920	\$7,500				\$7,500	
44					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
45	\$1,920				\$1,920	\$7,500			\$375,000	\$382,500	
46					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
47	\$1,920				\$1,920	\$7,500				\$7,500	
48					\$0	\$7,500	\$5,000	\$25,000		\$37,500	
49	\$1,920				\$1,920	\$7,500				\$7,500	
50				\$375,000	\$375,000	\$7,500	\$5,000	\$25,000	\$375,000	\$412,500	
Net Present Worth (6%)					\$2,544,382						\$2,849,778
Net Present Worth (8%)					\$2,071,614						\$2,680,472
Net Present Worth (12%)					\$1,470,467						\$2,556,110

APPENDIX C – ENGINEERING EVALUATION

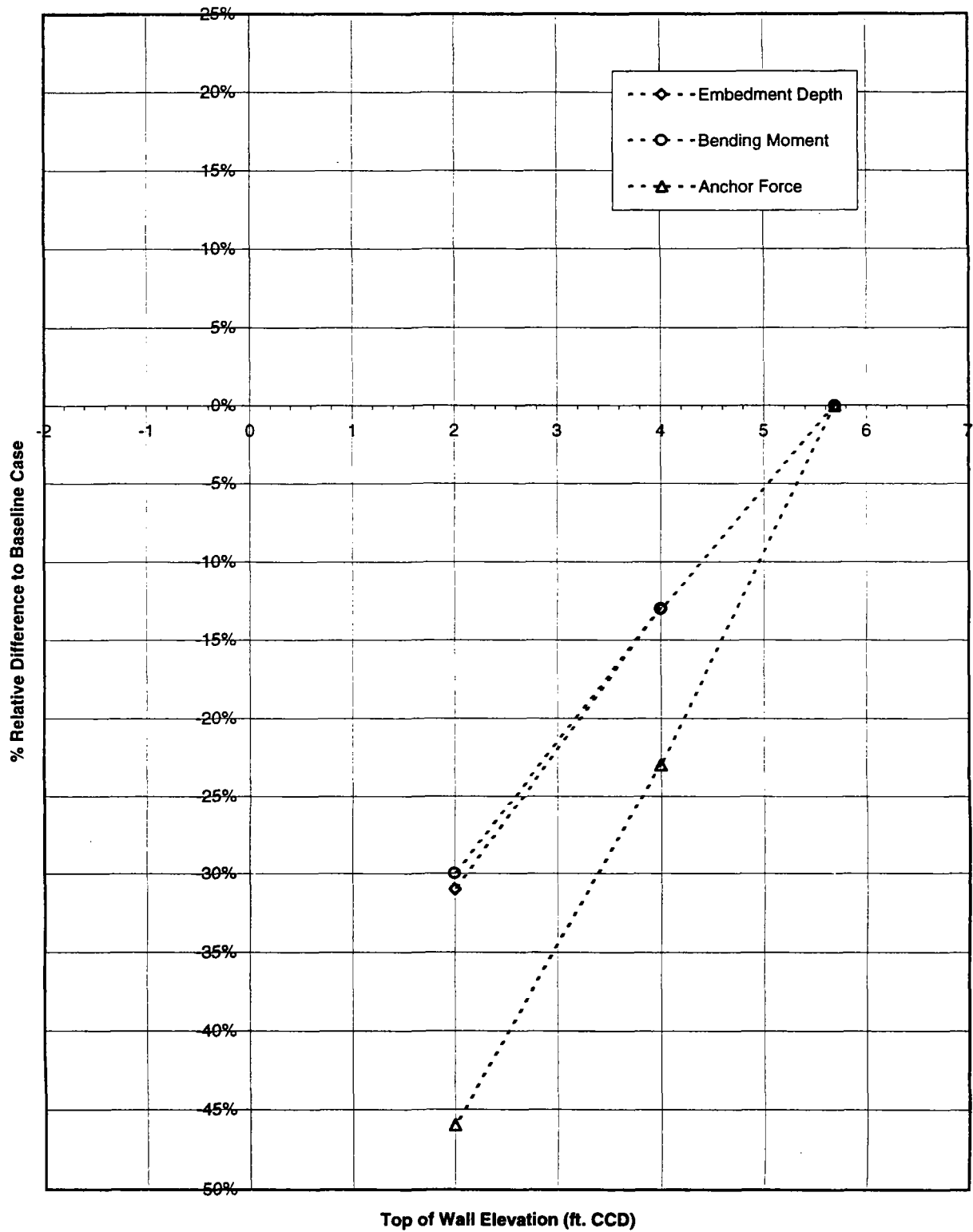
North Wall Parameter Sensitivity to Lighter Fill Material



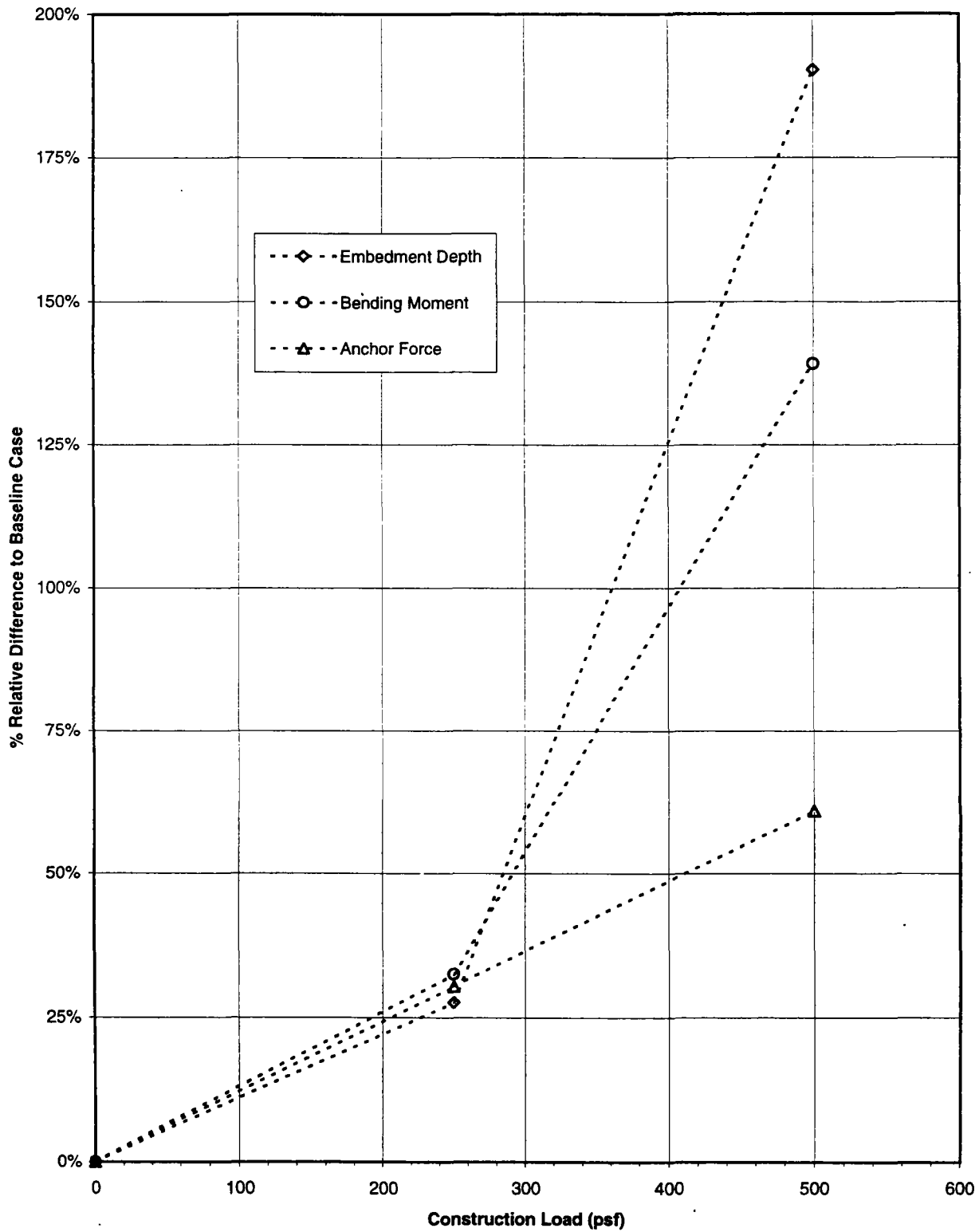
North Wall Parameter Sensitivity to Toe Berm



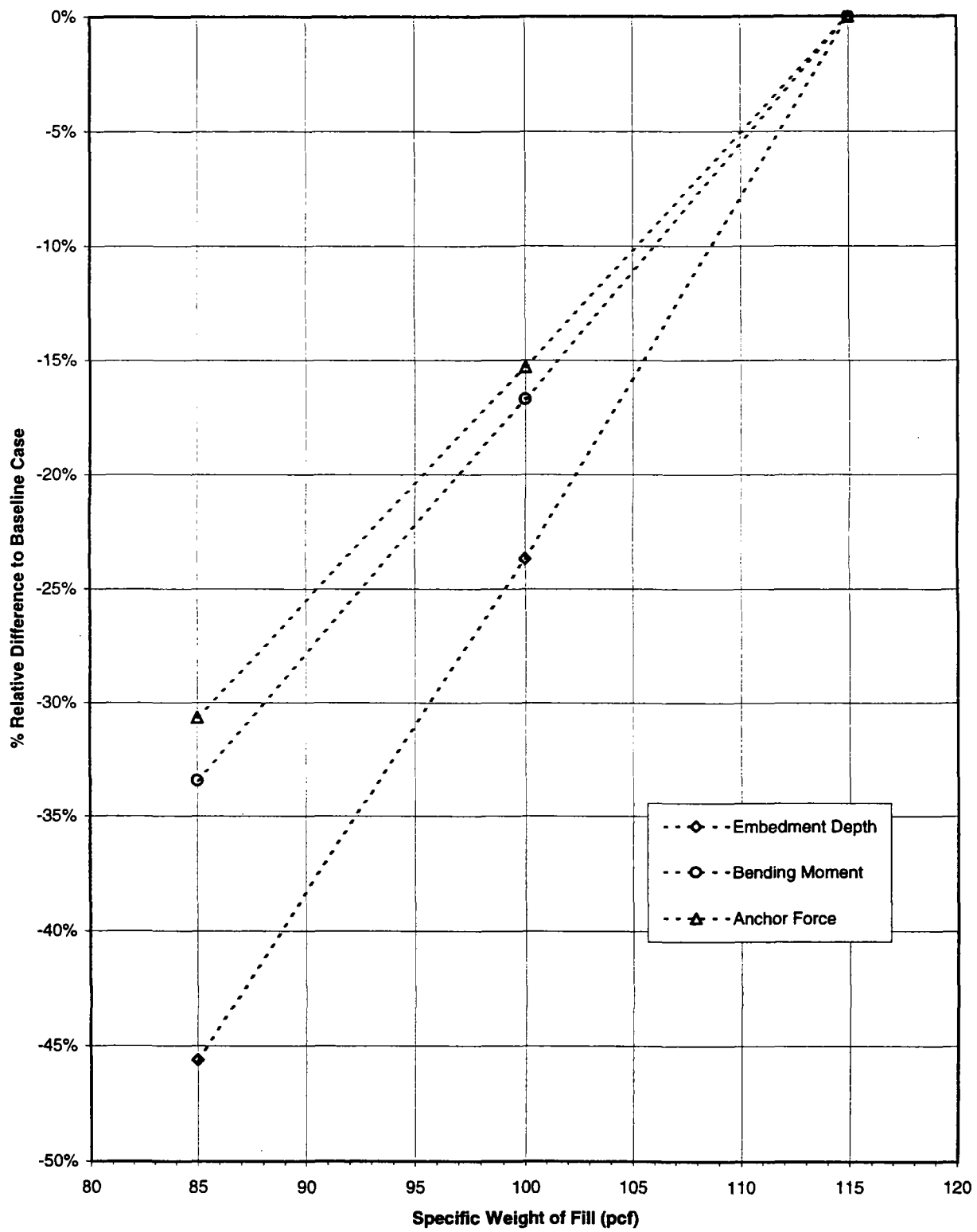
North Wall Parameter Sensitivity to Top of Wall Elevation



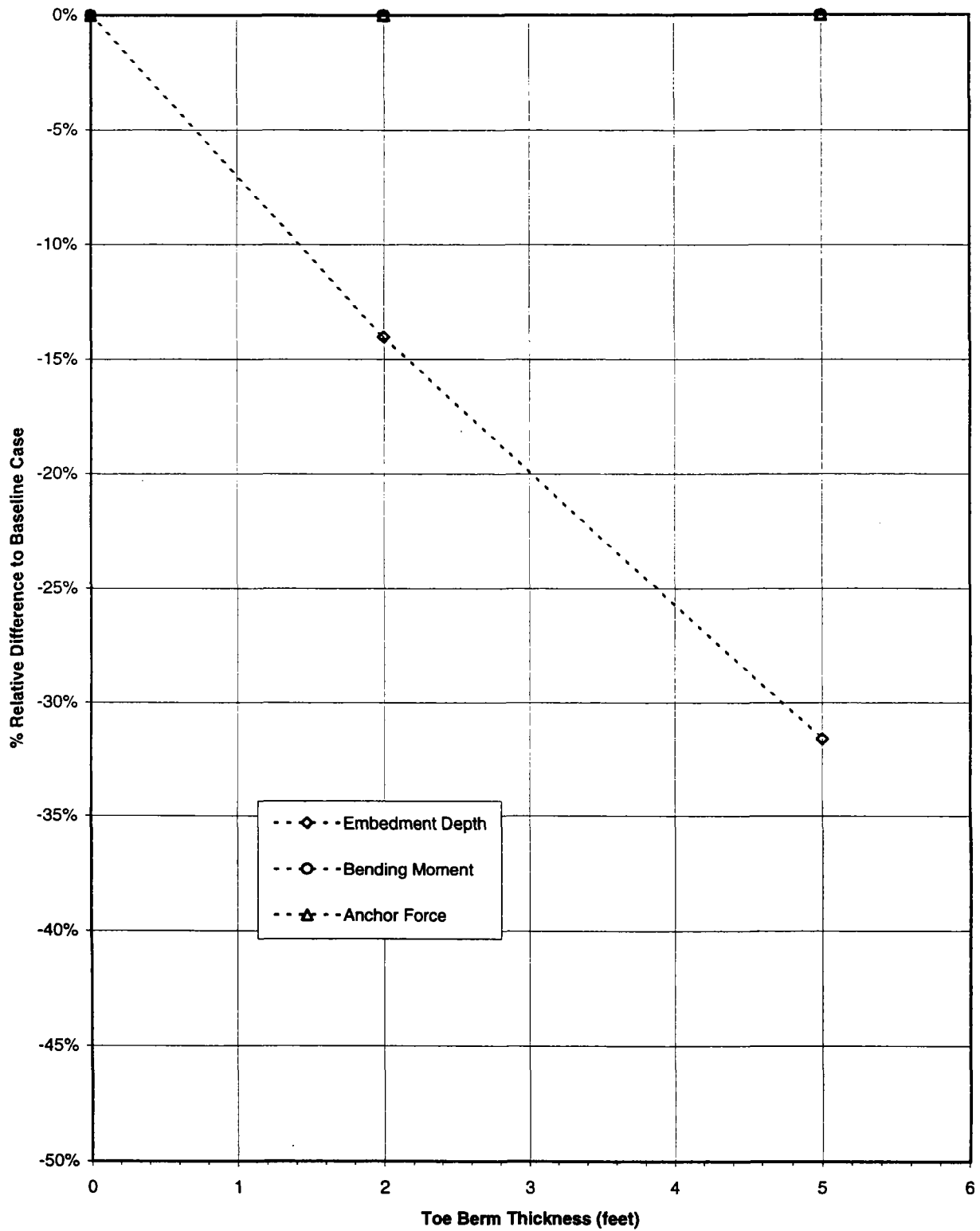
North Wall Parameter Sensitivity to Construction Load



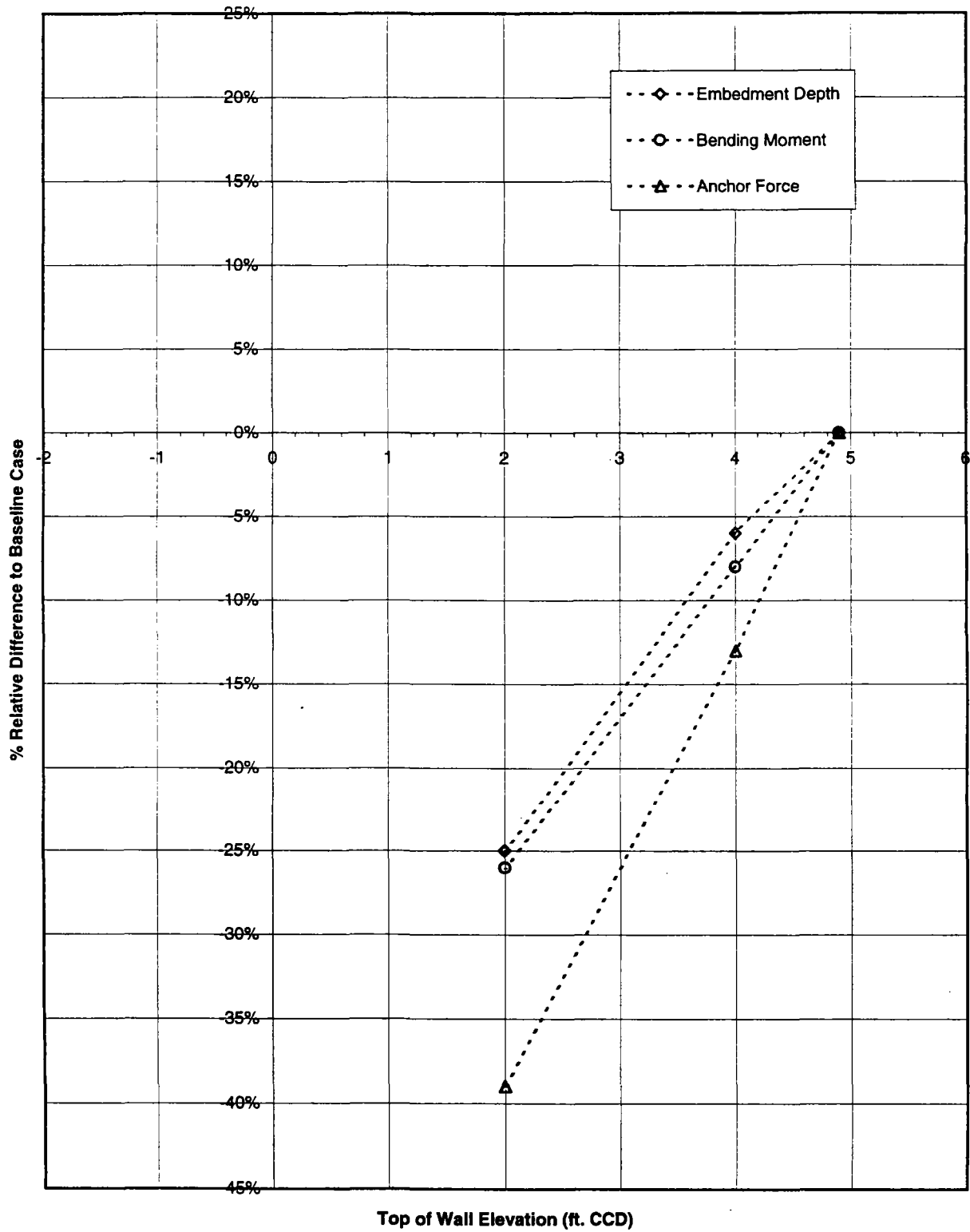
East Wall Parameter Sensitivity to Lighter Fill Material



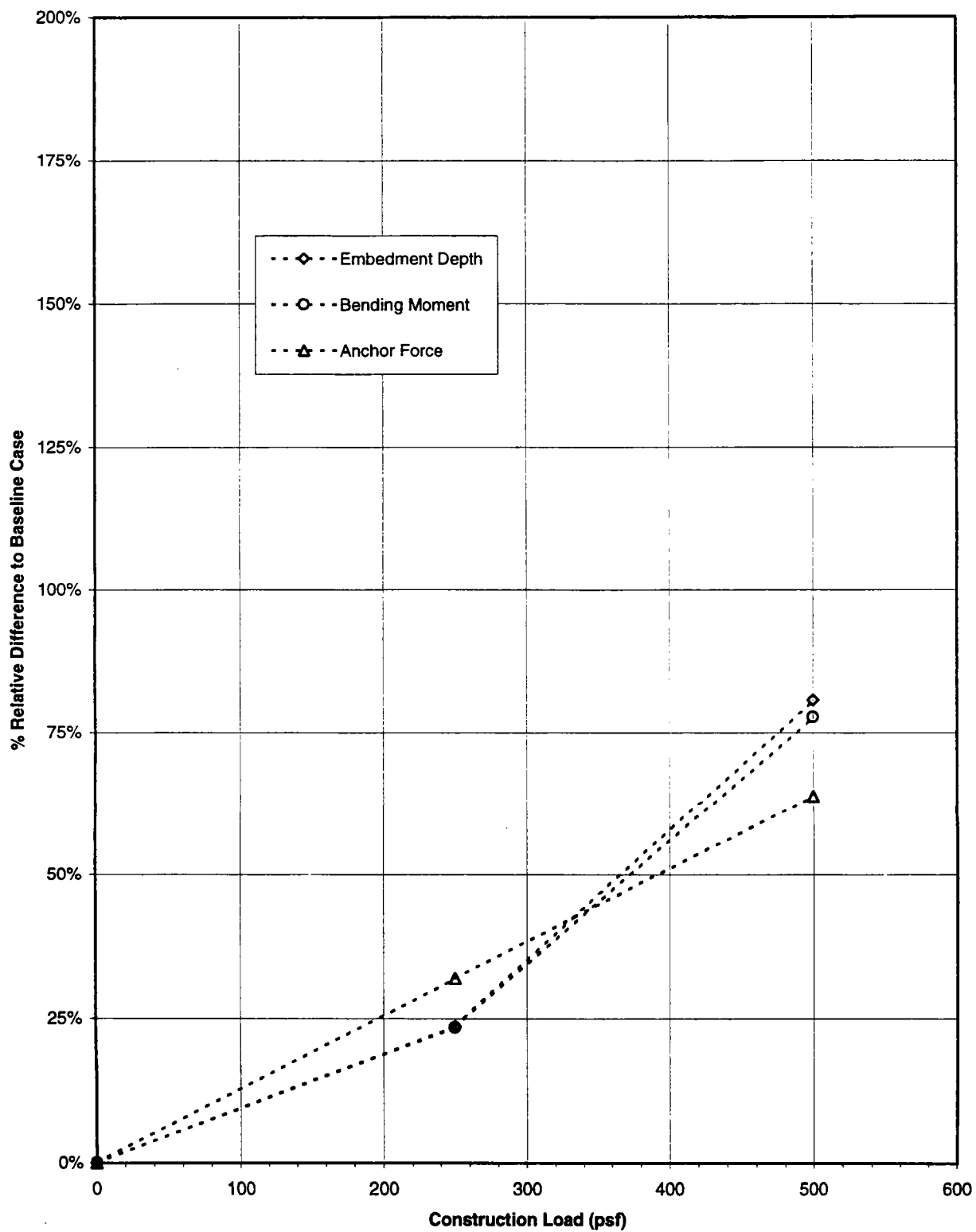
East Wall Parameter Sensitivity to Toe Berm



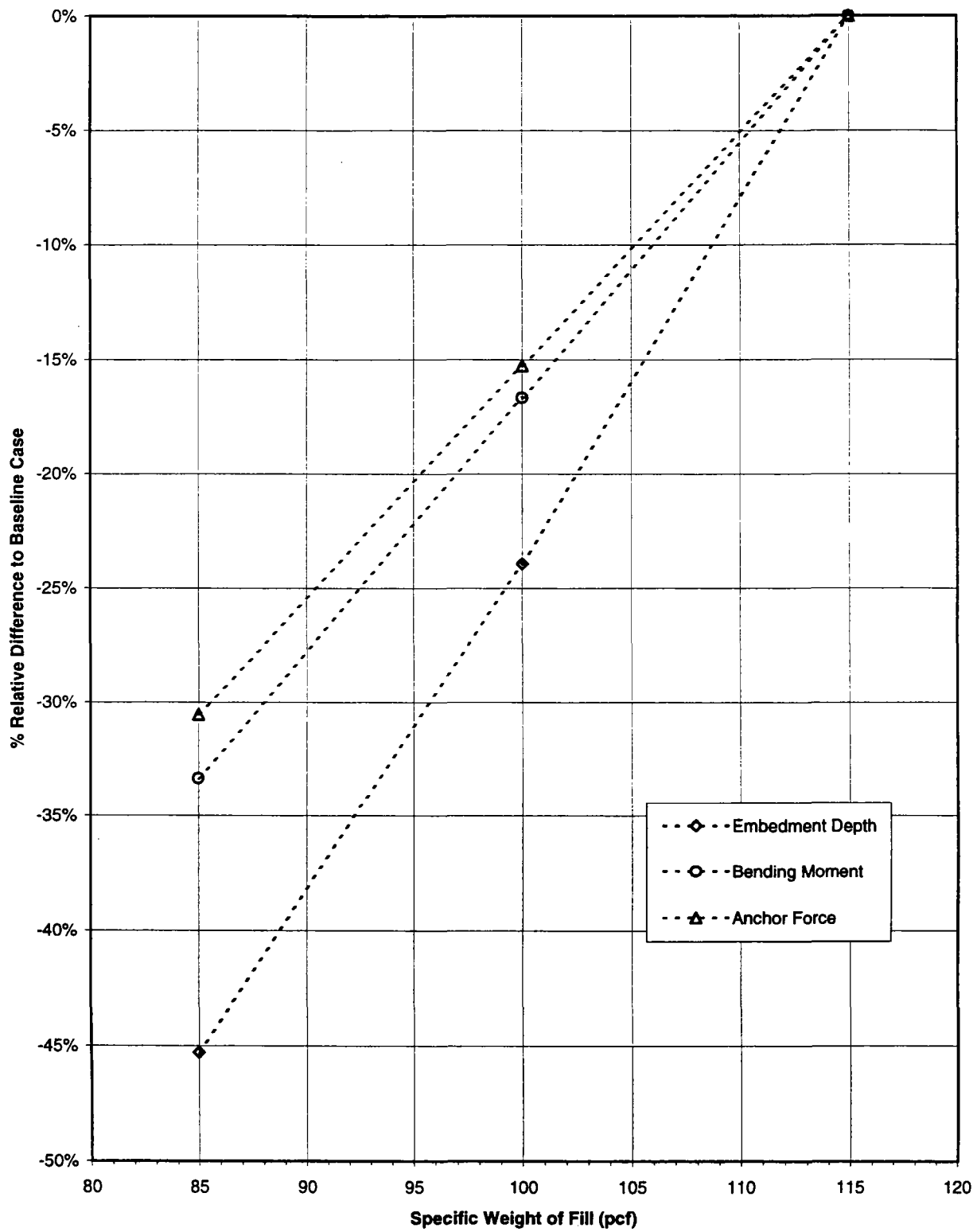
East Wall Parameter Sensitivity to Top of Wall Elevation



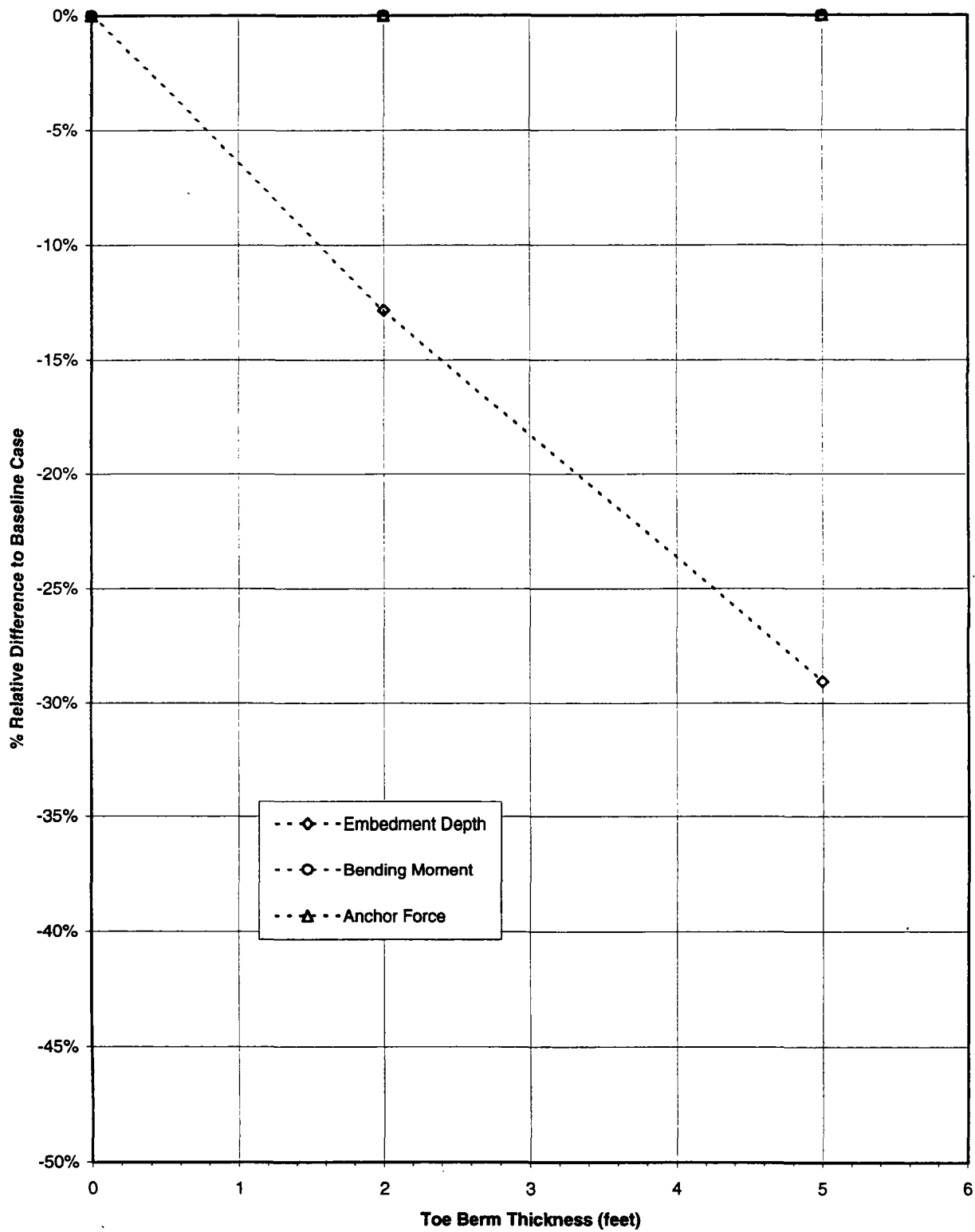
East Wall Parameter Sensitivity to Construction Load



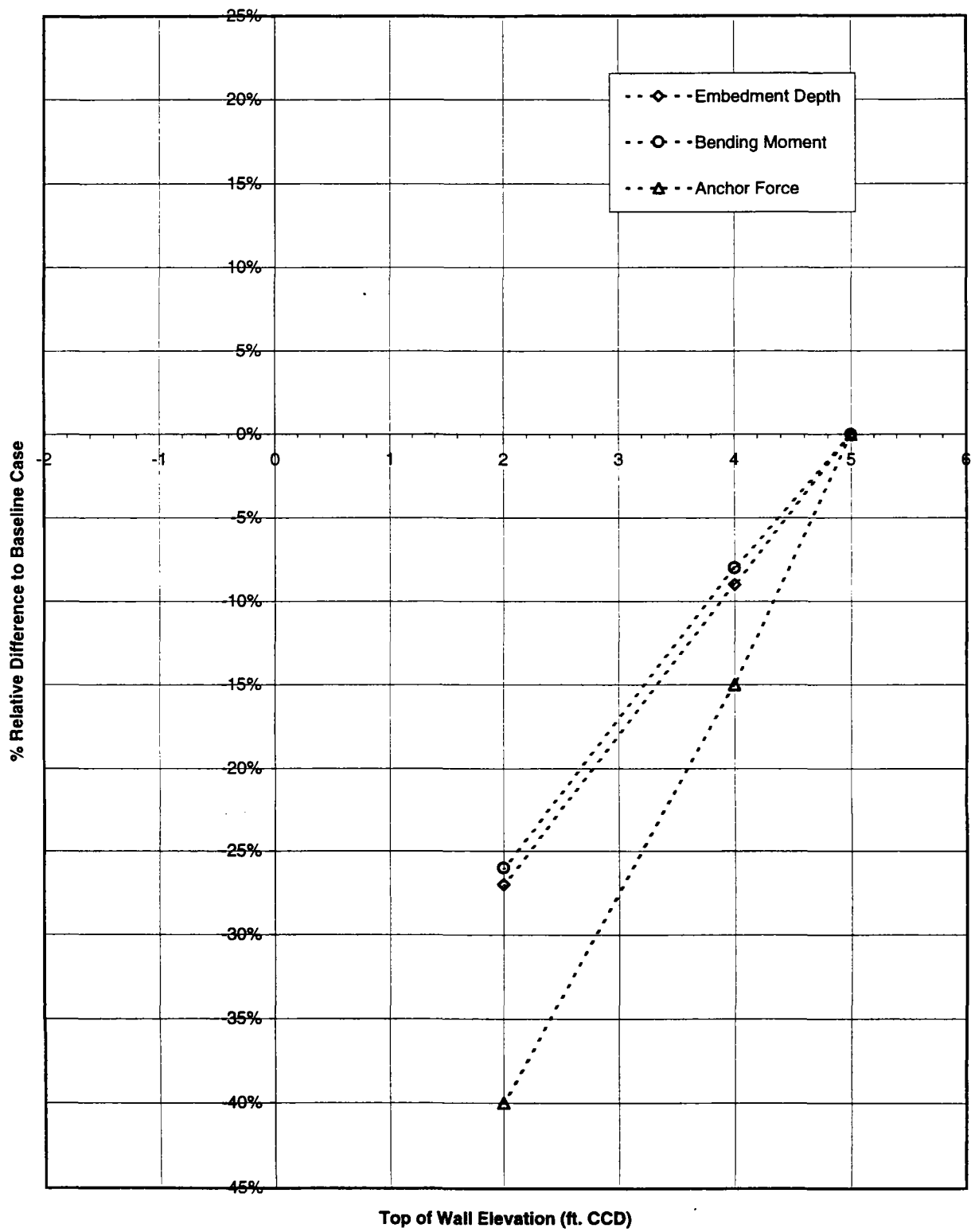
South Wall Parameter Sensitivity to Lighter Fill Material



South Wall Parameter Sensitivity to Toe Berm



South Wall Parameter Sensitivity to Top of Wall Elevation



South Wall Parameter Sensitivity to Construction Load

